UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL MARKETING SERVICE

AGRICULTURAL ESTIMATES DIVISION

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Report on

1955 RESEARCH SURVEYS

BY

THE RESEARCH AND DEVELOPMENT STAFF

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1. Introduction

Shortly after the close of the 1954 growing season, a consolidated report was issued on the findings of the various research activities undertaken during the year under the expanded project. That report consolidated a number of miscellaneous progress reports that had been issued earlier during the year. This report on activities during 1955 has been prepared to provide a set of notes in which activities throughout 1955 are recorded in similar fashion. Pressure of work prevented the publication of this report earlier.

The analysis of data collected during 1956 has already progressed to the point where conclusions that were drawn at the end of 1955 could now be amplified considerably. However, to be consistent, everything that is said in this report applies only to work during the 1955 season. The pattern of surveys conducted during the year conforms closely to what was done in 1954. Field activities were again under the direction of the Special Statistics Branch, with the Research and Development Staff being primarily responsible for the technical aspects of the work and the analysis of the data.

The acreage and livestock survey conducted in June 1955 covered basically the same sample of segments used in the Southern States the previous year. The non-open county segments, which in 1954 were found to be too large and too few in number for maximum efficiency, were reduced in size and a correspondingly larger number included in the sample. The open segments were identical with those used in 1954.

In addition to the area sample, a supplementary list of 1,000 large farms was also selected for enumeration in the same counties covered by the area segments. One hundred additional segments were also selected in 85 new counties for pilot studies on the closed segment approach.

Mail surveys were again conducted as of October 1 and December 1 for data on harvested crop acreage, reported crop production, and livestock inventories. About 1,100 questionnaires were mailed as of October 1 and about 600 as of December 1 to subsamples of the farmers interviewed. A sample of 330 non-respondents to the October Survey, which dealt largely with crop acreages and production, was interviewed. But instead of interviewing non-respondents to the December Survey, which dealt primarily with livestock numbers, an independent sample of 325 farms was selected for interview parallel with the mail sample to eliminate the time lag between the mail and interview portions of the survey. Two mailings were used in the mail part of both surveys and base data obtained for the same farms in June were entered on the questionnaires before they were mailed. It was hoped that this device would increase the mail response rate and would also tend to maintain a greater degree of consistency in the farming units for which respondents reported by mail as compared with the June interview.

Objective yield studies on cotton and corn were conducted on about 400 fields for each crop in 1955 as compared with about 200 of each in 1954. Although the number of fields was doubled, the number of farms on which those fields were located was approximately the same as in 1954. The field observations were about the same as those made in 1954, except that observations on corn were started as of August 1, rather than September 1.

About 60 wheat fields were used for objective yield data in Texas and Oklahoma in the Spring of 1955, but because of severe drought, it was possible to make such observations in only about one-half the fields selected for study.

2. Summary of Results

Results from the June Survey indicated that revisions made in the questionnaire for 1955 effectively eliminated the over reporting of certain items that was encountered in 1954. The use of the supplementary large farm list resulted in some reduction of sampling errors, but difficulties were encountered with the use of the list. Large operations often involved complicated tenure arrangements. It is not always practicable to arrive at a clean separation between land that should be considered part of a large farm and land that should be considered a separate operation and part of the universe covered by the area sample. In addition, it is sometimes difficult to determine the headquarters or location of residence for large corporations which are spread over several states. Reducing the size of the non-open country segments and including a larger number in the sample improved the efficiency of the sample and facilitated field operations.

Results from the small-scale study on closed segments were very gratifying and led to the conclusion that the 1956 survey should be run entirely by that method with the possible exception of livestock numbers. Experience was not sufficient to reach specific conclusions as to whether or not livestock numbers should be obtained by that method rather than by the farm approach, although preliminary indications were that the closed-segment approach would be satisfactory.

Results from the October and December surveys suggest that in an integrated program of surveys of this nature, such surveys should be conducted entirely by interview rather than partly by mail if any appreciable improvement is to be attained over procedures already in use by the Division. Although response rates to the mail surveys were improved in 1955, the interviews still had to carry a relatively high fraction of the total weight in the estimates. Furthermore, there was still some lack of comparability in the farming units for which respondents reported by mail, as compared with the units defined at the time of the June interview.

Objective yield studies on cotton led to the development of forecasting equations which seemed to be consistent with the development of the plants throughout the season. Definite procedures were set up for making experimental yield forecasts in 1956. Early in the season these formulas make provision for fruit still to be formed on the plants, while later forecasts depended largely upon predictions of the amount of fruit on the plants that will reach maturity.

Studies on corn indicate that in the South most of the ears are already present at the time of the August 1 Survey, so that the forecasting problem in that area reduces mainly to predicting size of ear at maturity. Ear length seems to be closely correlated with the amount of grain produced. The ear seems to reach its maximum length fairly early and thus serves as an early indication of weight of grain per ear at maturity.

Studies on wheat were complicated by heavy abandonment and partial combining of some of the sample fields. This made it difficult to determine the acreage actually intended for harvest. It was planned to restrict field observation to acreage for harvest, only. Experience in the Spring of 1955 suggests that it is better to think in terms of the total acreage actually standing than to attempt to estimate the portions actually intended for harvest. The objective field observation would then apply to all acreage actually standing as of a given date. The objective observations indicate that it should be possible to arrive at a procedure for forecasting the number of heads to be produced, from a count of stems, early in the season. It also appears that the weight of grain per head is closely related to length of head and that heads reach their maximum length shortly after they begin to appear.

Because of the necessity for reconciling objective yield indications with yields reported by farmers, it is important to know whether farmers tend to report crop acreage in terms of the gross sizes of the fields, or whether they report in terms of the net acreage on which the crop is actually present. Intensive measurements were made on a sample of about 50 fields growing each of the following crops: cotton, corn, sorghum, and soybeans. Results indicated that cotton, which is grown under rigid allotments, is reported on a net basis, but that acreage for the other crops tend to be reported in terms of gross field sizes.

It was also discovered that the crop actually found to be growing in a selected field at the time of the quality check was sometimes different from the crop reported at the time of the June Survey. It is possible that some crops reported in June had not yet been planted by that date and that departures from intentions may have occurred between the time of the June Survey and actual plantings. But it is also possible that farmers sometimes make errors in identifying particular fields under discussion on the aerial photographs and ascribe a crop to the wrong field even though the acreage itself is reported accurately. Further studies are needed to determine the reason for such discrepancies and to learn whether or not they have a tendency to average out.

3. The June Enumerative Survey

3.1 Purpose

This was the second June Enumerative survey made as part of a broad research program aimed at developing an improved crop and livestock reporting system. The system visualized in connection with this survey consists of a probability area sample of farms being interviewed in June of each year to obtain data on planted crop acreages and livestock inventories, with objective plant observations and farmers' appraisals of crop prospects and final yields being obtained for important crops on a subsample of those farms at monthly intervals during the growing season, and with mail or interview surveys being made on the entire sample during the year to estimate harvested crop acreages, final crop production, and end of year livestock inventories. Studies leading to the development of an improved system, which is at present assumed to be of that general character, are being conducted under simulated operating conditions in the belief that this is the most efficient procedure for studying the suitability of proposed methods and for incorporating the results of the studies in the regular operating program.

It was the first survey of the 1955 season, during which the same cycle of surveys conducted during 1954 is being repeated. The June survey provides basic data on planted crop acreages and livestock inventories, to which are tied the objective plant observation surveys, and mail and interview surveys on a subsample at intervals during the remainder of the season. Work in the June 1955 survey should be viewed in the light of experience with the June 1954 survey. In 1954, several deficiencies in the manner in which the survey was conducted became evident. The sample grossly overestimated the acreage of cotton as indicated by ASC measurements. Estimates for all other major crops and all classes of cattle were also significantly higher than Board figures. Sample estimates for hogs, sheep and chickens were below those of the Board.

At the end of the 1954 season the following recommendations were made to correct these deficiencies:

1. Enumerate all "large" cotton, corn, wheat, and livestock farms in the 100 sample counties.

2. Increase the number of non-open-country segments but reduce their size.

3. Clarify definitions of a farm, a farm operator; properly classify tenants and croppers; and emphasize the need for more careful screening of managers and non-resident operators by enumerators. Use a "balance sheet" type of schedule to account for the use of all land in the farm, to eliminate crops on land rented out, and to insure that all land rented in, for which crops are reported, is included in the reported farm land.

These recommendations were adopted in the 1955 survey. The effects of the changes on the level of the estimates and the sampling errors of some of the more important items in the survey are discussed in this report.

3.2 Summary and Recommendations

All the changes made in the 1955 survey seem to have been made in the right direction. So far as can be determined there was no bias in the June 1955 survey. It is believed that estimates of any given reliability can be made for major crop and livestock items in the survey by an appropriate increase in the size of the sample.

Estimates for cotton, corn, cattle and hogs, using the "large farm" list are not significantly different from those made by treating all farms alike, i.e., adding the data for large farms with the operators' residences within the selected segments to all other segment data and expanding as in 1954. Use of a "large-farm" list does provide certain safeguards by limiting the effect of extremely large operations on the sample, but it is somewhat of a problem to keep the list up-to-date. Refusals are higher in this group of farmers also. Breaking up the non-open country segments eliminated large pockets of farmers and was one of the two major factors in bringing the 1955 estimates more in line with other indications. The other major factor was the clarification of the definition of a farm and proper assignment of land to cash and share tenants and croppers. The appropriate interview procedure seems to be to get a record of the total operation over which the farmer considers he has any control. Then separate out the acreage farmed by cash and share tenants and croppers. The apparent "over reporting" of cotton and corn acreages in 1954 indicates that when a farmer is asked about his operations he tends to report all cotton and corn over which he has any degree of control, however slight. It seemed satisfactory to get the acreages of cash and share tenants individually and those for the croppers in a lump sum. Livestock were recorded separately for the operator, each cash and share tenant and in a lump sum for croppers.

The small "closed-segment" sample more than met the expectations of the research staff. It has many favorable aspects including reduction in segment to segment variation, simplicity of concept and better control over the quality of work of enumerators. The many advantages of the "closed-segment" approach led the research staff to recommend that the entire June 1956 survey be on a closed-segment basis. It also recommended that the survey be spread over more counties with fewer farms per county. About 10 farms per county rather than 35 and about three times as many counties seemed to be near the optimum distribution taking into consideration sampling errors, administrative problems and funds available for the June 1956 survey.

3.3 Sample Design and Size

The main or "open-segment" survey covered the same segments in the 10 Southern States as the 1954 survey except that the nonopen-country segments were increased from 25 to 79 and their size reduced proportionately. A detailed explanation of the sample design is given in the 1954 Report on Research Surveys. In addition a "large" farm list was used to improve the accuracy of the estimates.

Also, a small "closed-segment" survey was made in the non-wheat stratum of the universe. In this survey crop acreages and livestock located within the boundaries of the segment were enumerated.

The size of the June 1955 survey and the June 1954 survey is shown in table 3.1.

Table 3.1 - Size of June 1955 and June 1954 Surveys

Item	June '55 Surveys		June '54 Survey
	Open Segment	Closed Segment	
	Number		
Segments	757	101	703
Farms:			
Seg. farms	2,683	---	2,875
Large farms	863	---	---

3.4 The Questionnaire

Two forms were used in the survey as in 1954: (1) a Farm Identification form designed to screen persons living inside the boundaries of each segment to determine whether or not they were farm operators, and (2) a farm questionnaire to be filled out for all persons who qualified as farm operators. In this survey a farm questionnaire was filled out for every person living inside the boundaries of a sample segment who qualified as an operator of a farm, regardless of where the land he operated was located. Criteria used to qualify persons as farm operators were the same as in 1954. The questionnaire was of the interview type and consisted of 16 pages in book-form and about 150 questions. The significant difference between the 1955 questionnaire and the one used in 1954 was that it permitted the farmer to report on "his farm" as he visualized it with provision to record any of the crops worked by tenants or croppers separately so that if necessary they could be deducted from the entire operation. The operator was asked to report separately the livestock owned by himself, his tenants and his croppers.

3.5 Large Farm List

Plans for 1955 included provision for some enlargement of the sample. It was thought that more improvement in accuracy would result from adding a supplemental list of large farms than from increasing the number of sample segments. A list of all known large farm operators was obtained in each of the 100 sample counties. All known farm operators residing in the counties, with 1,000 or more acres of farm land (2,000 or more in a few Texas counties), were listed. From the list of about 3,000 such farms in the 100 counties, a sample of 1,000 was selected for interview. These were selected by judgment on the basis of size and amount of land under cultivation. Those not selected were regarded as not on the "large-farm" list. They were not interviewed unless they happened to be in the sample segments, in which case they were considered as part of the area sample. The 1,000 large farms retained on the list for interview were allocated to the individual sample counties on the basis of the weighting factor to be applied to the estimated county total in arriving at regional estimates from the sample data, and on the amount of cropland on all large farms in the county appearing on the original list. That procedure threw the bulk of the large-farm interviews into the counties where they were most effective. Questions as to the eligibility of some large farms on the list caused some difficulties in the field enumerations

and in editing. Large-farm lists seem to get out of date quicker than other farm lists. Also, the corporate nature of the farm ownership sometimes makes it difficult to determine the residence of the owner.

Estimates for the region for cotton planted, corn planted, all cattle and all hogs made by expanding the segment data and adding in the "large" farms are compared in table 3.2 with estimates made by treating "large" farms in segments the same as all other farms. This latter estimate should be comparable to the 1954 estimate except for the revision in the nonopen-country segment portion of the sample.

Table 3.2 - Effect of "large-farm" list on level of estimates of certain items in 1955

Item (1)	Unit (2)	Survey comparable to 1954 1/ (3)	Using entire large farm list (4)	Check data (5)
cotton, planted	1,000 acres	16,407	17,762	2/ 16,024
corn, planted	1,000 acres	15,188	16,128	3/ 15,658
cattle, all	1,000 head	25,652	26,217	4/ 27,240
hogs, all	1,000 head	8,300	8,449	4/ 8,958

1/ Data for "large" farms in sample segments treated same as all other farms.
2/ ASC measurements.
3/ July Board.
4/ January 1, 1955 Board estimate projected to June 1, 1955.

The effect of adding the large-farm list on the sampling errors for the above mentioned items is shown in table 3.3.

Table 3.3 - Effect of "large-farm" list on sampling errors of certain items in 1955

Item	Survey comparable to 1954	Using large farm list
	percent	
cotton, planted	14.2	13.7
corn, planted	7.5	7.3
cattle, all	9.5	8.9
hogs, all	10.5	9.4

Taking into account the imbalance in the sample for the above items as indicated in the section on "County Selection Factors" it appears that the addition of the large farm list contributed very little to the accuracy of the estimates for cotton, corn, cattle and hogs. This conclusion assumes that except for ASC measurements of cotton, the check data, although helpful, are subject to an unknown amount of error. The large farm list should be regarded primarily as providing some insurance against wide fluctuations in the level of estimates. There was some reduction in sampling errors in the above mentioned items but it is not of any great magnitude.

3.6 Nonopen-country Segments

A major weakness in the 1954 sample design was the size of the densely-populated urban segments. These urban segments contained excessively large numbers of households to be canvassed in the process of hunting for farm operators. In several such segments a very large number of operators was picked up. In fact, it was necessary to subsample two of the heavily-populated segments. Double reporting in the form of nonresident operators and managers or tenants claiming the same land, no doubt added to the suspected bias in this portion of the sample. Thus, it became apparent that the canvassing operation and the statistical efficiency of the sample would both be improved by making urban segments only about one-third as large as in 1954 and using three times as many. This was done in 1955. The canvassing operation in the smaller urban segments proceeded much more smoothly than in the larger segments used the previous year.

A sharp drop from 1954 to 1955 occurred in the level of the data reported for most items in these nonopen-country segments. The drop reflects elimination of large pockets of operations, proper assignment of tenant acres and classification of owners rather than managers as operators. The effects of the latter two actions are discussed more fully in the next section of the report. Comparisons of the expanded data for certain items in these segments in 1954 and 1955 are shown in table 3.4

Table 3.4 - Expanded data for certain items in non-open-country segments

Item	Unit	1954	1955 1/	Difference
cotton, planted	1,000 acres	4,217	1,225	- 2,992
corn, planted	1,000 acres	3,265	1,361	- 1,904
cattle, all	1,000 head	5,743	3,709	- 2,034
hogs, all	1,000 head	1,198	630	- 568

1/ Large farms in these nonopen-country segments treated the same as all other farms.

Sampling errors for the two years were calculated for the cotton, corn, cattle and hog data reported in the nonopen-country segments. Some improvement is noted but not as much as was expected. These sampling errors are shown in table 3.5.

Table 3.5 - Sampling errors in non-open-country segments

Item	1954 sampling errors percent	1955 sampling errors percent
cotton, planted	39.6	34.8
corn, planted	29.3	31.2
cattle, all	39.4	31.8
hogs, all	47.8	33.7

3.7 Definition of a Farm and Farm Operator

In the 1954 survey some difficulties were experienced with farm identification and the reporting of crop acreages. All farm operators living in the sample segments were to be interviewed. Tenants, other than croppers, and managers were defined as operators. It became evident that distinctions between bonafide managers and foremen who should not be classed as farm managers were not always properly maintained. Because of difficulties in determining whether or not an individual who called himself a manager should in fact be so regarded and classified as the farm operator, it was decided not to define any managers as farm operators. In 1955, all farms operated by managers or so-called managers were included in the sample only when the owner or lessee of the land lived inside the sample segment. So far as can be ascertained, this procedure worked well except for some large corporate farms and practically eliminated the possibility of manager-operated farms having a double chance of getting into the sample.

The problem of farm definitions has always been troublesome because farm operators do not always think of their operations according to rigid statistical definitions. In 1954, a farm was intended to consist of all land owned and rented in, minus land rented out to tenants other than croppers. The questionnaire provided enough detail so the farm land could be properly classified according to that definition. The operator was then questioned about crops and livestock relating only to what was defined as his operation. Upward biases in reported acreages occurred for some crops, particularly those commonly grown on a share or share-rent basis. Apparently most such crops were double reported by landlords and tenants. Even though farmers correctly reported land rented out when questioned specifically about that matter, they still tended to report crops grown on such land when questioned about crop acreages.

This difficulty seems to have been overcome in the 1955 survey. Instead of attempting to restrict the farmer's concept of his operation to a rigorous statistical definition of what constitutes a farm he was asked if he rented any land out, and if so could he report on all his land including that rented out. Any land rented out that the farmer could not report on was deducted from the total acres reported. He was then asked to report the entire acreages of crops on the farm operation which he knew about. In the last section of the questionnaire -- Tenant Summary -- the acreage for each crop farmed by each tenant (other than croppers) was recorded. To make sure that all crops were reported in full, the farmer was then asked whether or not all of the crops reported for his tenants (other than croppers) were also included in the report for his own operation. If

any crops were omitted, as they were occasionally, such crop acreages were circled and added to the farm totals. Finally, the livestock kept on the farm by the operator and by each tenant (not cropper) was obtained together with a lump sum figure for each class of livestock kept by croppers. By this approach it was possible to assign reported crop acreages and livestock numbers to the appropriate operators according to definitions and to eliminate double reporting. There may be some question about the accuracy with which data on tenants' operations can be reported by the landlord, but errors from that source seem to be small in relation to errors caused by double reporting, such as were encountered in 1954. Most landlords seemed to be well acquainted with their tenants' operations and were able to supply the data requested.

Tenants who qualified as farm operators in their own right were considered part of the sample only when they lived inside a sample area segment. If they farmed no land other than that covered in the landlord's report, it was unnecessary to interview them. The only tenants who needed to be contacted were those who lived inside sample segments and who farmed land in addition to that covered in the landlord's report, or for whom the landlord was unable to supply data because of insufficient familiarity with the tenant's operation. Acreages of crops worked by tenants who qualified as operators, but who lived outside the segments, were deducted from the gross acres reported by operators.

An effort has been made to obtain an indication of the effect of the elimination of managers as farm operators, proper assignment of tenant acres and better enumeration in general on the level of estimates of cotton and corn. These changes in concept should not have effected livestock estimates since separate inventories were obtained for landlords and tenants in both surveys.

This analysis is restricted to open-country segments because in the non-open-country segments the effect of changes in the schedule are confounded with changes in segments. For cotton the percent change in ASC measurements of acres planted was applied to the 1954 estimate for open-country segments. These measurements show 90 percent as many acres planted in 1955 as were planted in 1954. The results are shown in table 3.6.

Table 3.6 - Indicated effect of changes in definition of farm and farm operators on level of cotton estimates in open-country segments

	Acres planted 1,000 acres
1955 est. open-country segs. (from percent change in ASC measurements applied to 1954 est. for these segs.)	18,220
1955 open-country segment estimate	15,182
Difference	- 3,038
Cotton on land rented to tenants (not croppers) living outside segs. in 1955	2,089
Remainder	949

From the analysis in table 5 it appears that in 1954 farmers reported all the cotton on all the land over which they had any control, regardless of the degree of control. This is what had been suspected over the years but the 1955 summary seems to provide the proof. The additional reduction of 949,000 acres was probably due to elimination of ineligible farms, and double reporting on manager-operated farms.

Farm operators in the survey reported 99.2 percent as much corn planted in 1955 as in 1954. This percent change was applied to the 1954 open-country segment estimate to derive a 1955 estimate, as shown in table 3.7.

Table 3.7 - Effect of changes in definition of farm and farm operators on level of corn estimates in open-country segments

	Acres planted 1,000 acres
1955 open-country seg. est. (from percent change in open-country segs. applied to 1954 est. for these segs.)	16,578
1955 open-country seg. estimate	13,827
Difference	- 2,751
Corn on land rented out to tenants (not croppers) living outside segs. in 1955	2,538
Remainder	213

Apparently farmers reported as a part of their operation most of the corn land rented to tenants living outside the segments similar to the way they reported the cotton acreage even though it was rented out to bona-fide operators. Similarly, the 213,000 acres difference shown in table 3.7 as remaining after deducting the corn acreage rented out, probably can be accounted for by elimination of acres of ineligible farms and managers as operators.

3.8 Closed Segment Survey

In 1955, a "closed-segment" approach was also tried in 101 segments dispersed over 85 new counties in the non-wheat stratum of the 10-State region. It was thought that by accounting for all crops growing within the boundaries of the sample segments, and for all livestock actually present within the segments at the time of the survey, it would be possible to avoid the necessity for defining farms and to avoid the difficulties involved in allocating crop and livestock data to the appropriate farm operators without duplication. Such an approach also has the statistical advantage of placing an upper bound upon the total amount of a crop, or the total number of livestock of a given species, that can be associated with any one segment and thus reducing the range of sampling fluctuations. Still another advantage is that reported crop acreages and field sizes can be verified by actual measurement on aerial photographs of the sample segments; such verification would be tedious and impracticable in large-scale surveys when the farm is the unit of observation.

A considerable background of favorable experience with this approach is available for crop acreages and land-use items. So far as crop acreages and land-use items are concerned, results from the closed-segment approach confirmed expectations. There was some doubt about its suitability for collecting data on livestock. Results in the 1955 survey indicate that livestock data can be obtained by this method satisfactorily. An upward bias seems to be present in the 1955 data because respondents in some instances tended to classify animals as present in the segments when some or all actually were outside the segment boundaries. But more care in the field work should eliminate that bias. Some interviewers reported that respondents were more willing to discuss livestock numbers in the segments than to talk about all their holdings. In view of the difficulty that statisticians usually encounter in attempting to get respondents to report all livestock on the farm, it is by no means certain that all of the differences found between the farm and the segment as the unit of observation should be charged to upward bias in the segment approach; there may be a downward bias in the farm approach.

Results from this small sample of "closed" segments were so favorable that the June 1956 survey in the 23 States will be made on this basis. However, to further test the "closed" segment approach vs. the farm headquarters method for obtaining livestock data, these questions will be asked both ways in 1956.

3.9 County Selection Factors

It is to be expected that the selection of counties with probabilities proportional to the number of farms in a county would not provide a perfectly balanced sample with only 10 percent of the counties in either the "open" or "closed" segment sample. Census totals of certain items in 1944 and 1949 for the counties selected were expanded to the universe level and compared with census totals for the 10 States to obtain some indication of this imbalance. ASC measured acres of cotton in the sample counties in 1950 expanded to the universe level also differed from the 10-State total of measured acres by about the same percentage as the expanded sample county census data. Percentage deviations of the sample county expansions from 1949 census totals for certain items are given in table 3.8.

Table 3.8 - Approximate deviations of estimates based on 1950 census sample county totals from 1950 census totals for 10 States

Item	Open Seg.	Closed Seg.
	percent	
cotton, acres	+ 7.3	- 4.0
corn, acres	- 0.5	- 9.4
cattle, all	+ 0.2	- 1.4
hogs, all	- 0.2	-12.2

It is interesting to note that on the basis of 1950 census data a combination of the two samples should provide a better balanced sample for cotton and cattle but would not improve the sample for corn and hogs. No doubt relationships have changed since 1950 but the above figures may be useful for adjusting the level of sample indications prior to comparison with check data.

3.10 Direct Expansions of Crop Acreages in "Open" and "Closed" Segment Surveys

Estimates of selected crop acreages obtained by expanding the "open" and "closed" segment data are compared with check data in table 3.9.

Table 3.9 - Direct expansions of selected crops compared with check data

Crop	Open seg. survey	Closed seg. survey	Check data
	1,000 acres		
cotton, planted	17,762	16,678	1/ 16,024
corn, planted	16,128	18,218	2/ 15,658
corn, for grain	14,219	15,396	3/ 14,210
wheat, all, planted	12,735	Comparable data not available 4/	2/ 10,294
wheat, all, harv. for grain	6,374		2/ 5,900
oats, planted	15,332	"	2/ 9,473
oats, harv. for grain	6,778	"	5/ 6,751
barley, planted	938	"	2/ 845
barley, harv. for grain	555	"	2/ 658
rye, planted	1,412	"	6/ 775
rye, for grain	247	"	2/ 175
soybeans, alone, all purposes	4,368	"	2/ 3,127
soybeans, alone, for beans	-	"	2/ 2,324
tobacco	1,026	836	2/ 972
peanuts, alone, all purposes	1,828	1,726	2/ 1,724
rice	1,428	1,510	2/ 1,501
sorghum, all	14,019	-	2/ 12,221
hay, all	-	15,548	2/ 9,433

1/ ASC measurements of total acres planted.
2/ July Board.
3/ Feed and Hay Section estimate, September 14, 1955.
4/ Closed segments restricted to non-wheat stratum; therefore, comparable data for small grains not available. For cotton and corn: data from open-segment survey in wheat stratum added to closed segment data to make regional estimate.
5/ Includes quantities cut ripe to feed unthreshed.
6/ December 1954 Board.

3.11 Ratio Estimates of Crop Acreages

It was not feasible to tabulate all the crop items on all schedules in time for use by the July Crop Reporting Board. Therefore, ratio estimates were prepared for selected items in time for use by the Board. These estimates are given in table 3.10.

Table 3.10 - "Open" segment ratio estimates of crop acreages compared with Board

Crop	Interview Survey	July Board
	1,000 acres	
cotton, planted	15,920	15,860
corn, planted	16,097	15,658
corn, for harvest	15,341	15,346
wheat planted, all	7,296	10,294
wheat, for harvest	5,798	5,900
oats, planted, all	8,844	9,473
oats, for harvest	1/ 6,418	1/ 6,751
barley, planted	438	845
soybeans, alone, all purposes	3,757	3,127
soybeans, alone, for beans	2,639	2,324
tobacco	1,017	972
peanuts, alone, all purposes	1,920	1,724
rice	1,314	1,501
sorghum, all	14,231	12,221
hay, all	10,778	9,433

1/ Includes quantities cut ripe to feed unthreshed

3.12 Reported Yields of Wheat, Oats and Barley

Farmers were asked in June for the production of the above named crops if they had already been harvested or for their best estimate of the production if the crop had not yet been harvested. The yields reported are compared with the July Board in table 3.11.

Table 3.11 - Indicated yields, compared with July Board

Crop	Open-segment survey	July board
	Bushels	Bushels
Wheat	11.2	10.1
Oats	31.5	24.6
Barley	16.1	15.0

3.13 Livestock Estimates

Livestock estimates from both the "open" and "closed" segment surveys are almost all within one standard deviation of the Board estimates. The December survey indicated that only about 75 percent of the sows expected to farrow in in the fall actually had pigs. The closed segment survey was only about 1/7 as large as the open-segment survey. The better control over segment size and smaller sampleing error make the closed segment approach especially desirable. As pointed out previously, it is believed that any upward bias in the closed segment data can be eliminated by better enumeration. The results are shown in table 3.12.

Table 3.12 - Research livestock estimates compared with Board

Livestock items	Open segment	Closed segment	Board 1/
	1,000 hds.	1,000 hds.	1000 hds.
All cattle	26,217	31,955	27,240
Cows and heifers 2+	14,907	17,017	15,100
All milk cows	4,876	4,406	4,176
Milk per cow	12.0	11.9	11.3
Calf crop, Jan. 1 - June 1	6,786	7,740	7,423
Calf crop, June 1 - Dec.31	5,444	6,116	4,286
All hogs	8,449	10,412	8,958
Spring sows farrowed	859	1,204	1,066
Pigs saved	5,645	7,414	7,059
Pigs per litter	6.4	6.14	6.62
Fall sows	1,108	1,363	941

1/ Board (revised) January 1, 1955 estimates adjusted for births and disappearance to June 1, 1955.

3.14 Total Number of Farm Operators and Number Keeping Livestock

A count was made of the number of eligible farm operators and those keeping livestock in the 1954 and 1955 surveys. It should be noted that this is a count of operators by our definition and that a sharecropper is not an operator. The comparison below assumes that the number of sharecroppers remained constant. No doubt, the number of sharecroppers decreased at a faster rate than the number of farm operators. On the other hand, the number of operators may not have decreased as much as indicated by the table since it is believed that a better job of determining eligible operators was done by the enumerators in 1955. The tabulations are shown in table 3.13.

Table 3.13 - Number of farm operators 1/ reporting certain livestock items in June Survey

Item	Nonopen country segs.		Open country segs.		Total segs.		Total segs. ratio
	1954	1955	1954	1955	1954	1955	1955/1954
	No.	No.	No.	No.	No.	No.	Percent
Eligible farm operators	437	336	2,438	2,347	2,875	2,683	93.3
Questionnaires tabulated	376	329	2,440	2,291	2,816	2,620	93.0
Farms w/cattle	238	206	1,914	1,826	2,152	2,032	94.4
Farms w/milk cows	160	123	1,708	1,628	1,868	1,751	93.7
Farms w/hogs	99	95	1,293	1,307	1,392	1,402	100.7
Farms w/spring farrowing	41	36	507	512	548	548	100.0
Farms w/sows bred	46	40	672	627	718	667	92.9
Farms w/hens laying age	160	160	2,066	1,932	2,226	2,092	94.0

1/ Sharecroppers by definition are not farm operators.

3.15 Acreage Verification

Important results from the acreage verification studies in 1955 are shown in table 3.14.

Table 3.14 - Acreage data as percent of total field size

Crop reported in field	Verification data			June data	
	Area planted to crop reported	Area in other crops	Unplanted area	Area reported as crop acreage	Photo measurement
	Percent	Percent	Percent	Percent	Percent
Cotton	90	5	5	96	97
Corn	97	-	3	102	95
Sorghum	80	16	4	109	96
Soybeans	89	8	3	106	99

After the field verification was completed and all necessary corrections and delineations made on the field sketches, each sketch was rotometered. This was accepted as the best possible estimate of the gross area of the entire field. Unplanted areas and areas devoted to crops other than the one which was reported as being in the field in June, were also measured. All measurements, including the acreages reported by farmers in June and the original photo measurements made immediately after the June Survey, were recorded as percentages of the correct gross field sizes. For example, in table 3.14, 90 percent of the gross field size was actually planted to cotton, 5 percent was devoted to crops other than cotton, and 5 percent represents unplanted areas of the field. Unplanted areas here refer only to areas which were normally uncultivated. If a portion of a field was left fallow for any reason, the fallow portion would be recorded as "other crops." The portion designated "unplanted" refers to portions of the field which would normally not be cultivated. The area reported as cotton acreage by the farmer at the time of the June survey amounts to 96 percent of the gross field size. This agrees closely with the total cultivated area of the field. The area of the field, as measured on the photograph immediately after the June survey, agrees closely with both the cultivated area measured on the corrected sketch and the area reported as cotton acreage by the farmer. It appears that reported cotton acreages agree closely with the measured cultivated areas of the fields. The fact that part of the field was sometimes used for crops other than cotton is not too disturbing. Farmers may have rearranged their planting plans between the time of the June survey and the time the crop was actually planted. ASC measurements were also obtained for the cotton fields in the sample. The results are not shown in the table but the total measured acreage amounted to 86 percent of the gross field size. This should logically be compared with the 90 percent shown in the first column of the table because no cotton would be measured unless cotton was actually planted.

For the other three crops listed in the table, acreages reported by farmers at the time of the June survey exceeded the total field sizes. For sorghum and soybeans the excess is appreciable, but in every case the photograph measurements made in June agree closely with the total cultivated areas of the fields. Crops other than the one reported in June were frequently found in the sample fields. This, again, can be charged at least partly to departure of actual plantings from intentions. When individual farm data are examined, it becomes apparent that there are often large discrepancies between data reported for individual fields in these three crops at the time of the June survey and the correct acreages as determined by measurement later. It is clear that farmers do not report net acreages when they are talking about non-allotment crops. It is also plain that they either do not know the correct field sizes on which those crops are grown, or at least take no particular pains to be careful about how they report acreages on such crops.

Results of the check on the scale of the photograph are not shown in the table. But on the average, the measurements actually found on the ground agree within 1 percent for each crop with measurements made on the photographs.

These comparisons of reported data with measured field sizes for individual fields shed considerable light on farmers' acreage concepts. But they tell us nothing about the extent of possible errors in reported acreages for the farm as a whole. The fact that crops other than the one reported were often found on the sample fields does not necessarily imply a serious error in a reported acreage for the farm as a whole. But it does suggest the desirability of conducting some studies to determine whether or not an acreage reported for the farm as a whole is correct. In the 1956 season, an effort will be made to conduct some verification

for all land in the sample segment coming under the control of a single operator, with comparisons being made between the total acreage reported for each crop and the total acreage actually found.

3.16 Sampling Errors

Sampling errors for a few major items in the June 1955 surveys are compared with the June 1954 surveys in Table 3.15. In examining the data the fact that the "closed" segment survey was only about 1/7 as large as the other surveys should be kept in mind.

Table 3.15 - Sampling errors in June 1955 surveys compared with 1954

Item	Unit	June '55 surveys		June '54 survey
		Open segment	Closed segment	
		Percent	Percent	Percent
cotton, planted	acre	13.7	10.7	14.3
corn, planted	acre	7.3	11.9	8.9
cattle, all	number	8.9	14.9	11.3
hogs & pigs, all	number	9.4	17.8	13.5

4. October 1 and December 1 Crop Production and Livestock Surveys

4.1 Purpose

The October 1 survey is made primarily for estimating harvested acreages and yields of major crops. The December 1 survey provides an estimate of the pig crop and January 1 livestock numbers as well as estimates of corn and cotton yields and acreage planted to winter wheat.

Table 4.1 - Size of October 1 and December 1 Surveys

Date	Ques. mailed	Useable Returns 1/		Interviews
	Number	Number	Percent	Number
Oct. 1	1132	405	35.8	330
Dec. 1	582	309	53.1	325

1/ Returns to first and second mailing that were usable for at least one item on questionnaire.

4.2 October 1 Survey

This was conducted by mail with non-respondent follow-up on a subsample of the open segments enumerated in June. Operators in one-half the segments were choosen for the mail sample. All operators residing within these segments and reporting any crops in June were mailed questionnaires on September 19 with reminder slips on September 23. Operators in one-half the segments receiving the mail questionnaires or one-fourth of all the segments were chosen for the non-respondent interviews, on the assumption that about one-third of the operators would return the questionnaires. Hence, the number of mail returns was expected to approximate the number of interviews. Interviewing was completed on October 4 so there was an interval of about two weeks from the time of the first mailing until the non-respondent interviews were completed.

Planted acreages reported in June were entered on all schedules in the Washington office, prior to the beginning of the survey. It was thought that this would help keep this report comparable with the June report, and at the same time encourage the farmer to return the questionnaire. About 41 percent of the questionnaires were returned, including first and second requests. Thirty-six percent of the returns were usable for one or more items. This was about the same response rate

as last year. The quality of reporting was good for cotton but deteriorated for corn and other crops. Ninety-three percent of the questionnaires listed were usable for cotton (counting reportes of "0" acres as usable questionnaire) whereas only 75 percent were usable for corn. These results are shown in table 4.2.

Table 4.2 - October 1 usable mail returns

Crop	Number listed 1/	Usable	
		Number	Percent
cotton	405	376	92.8
corn	405	304	75.1

1/ If a farmer reported zero acres of a crop in June, that zero was entered on the schedule before it was mailed. All zeros were classed as usable reports.

Planted acres of major crops reported in October agreed very closely with June reports covering the same respondents. Acreage and yield indications from the mail inquiries and nonrespondent interview separately and combined, using these October acreages, are shown in tables 4.3 and 4.4.

Table 4.3 - Percent of planted acreage harvested

Crop	Mail	Interview	Combined
cotton	96.5	96.5	96.5
corn	85.3	89.4	88.0
wheat	58.8	65.5	61.4
oats	39.2	47.3	44.4
barley	49.1	39.4	42.2
rye	11.9	26.0	22.6

Table 4.4 - Yield per acre, October 1 Survey

Crop	Unit	Mail	Interview	Combined	Dec. Board
cotton	pounds	313	319	316	380
corn	bushels	26.6	30.4	29.2	28.4
wheat	bushels	11.1	12.0	11.5	10.2
oats	bushels	30.5	31.2	31.0	25.2
barley	bushels	13.2	1/ 31.3	25.3	16.3
rye	bushels	9.0	10.6	10.4	8.8

1/ Reports of one interviewer questionable

Although there is a wider difference between the mail and interview reports on yields of corn than of cotton, apparently neither of these differences is statistically significant. As was the case last year, the reports under-estimated yield of cotton during the harvesting season. The October 1 estimate of corn yield is 0.8 bushel higher than the December Board figure. This is also similar to the situation last year.

4.3 December 1 Survey

Comments from the field indicated that the sample design for the December 1 survey should be modified. In a number of instances there was only one nonrespondent left in a segment and a good deal of travel was required for the number of interviews made. Also, with the post-harvest objective yield work being scheduled for about this date, it seemed logical to combine the two surveys. The Livestock Branch indicated that hog numbers change rapidly during late November and December when slaughter is at a high level. They felt that any livestock survey during this period should be made in a very short period to reduce bias. It was decided to separate the mail inquiry from the interview. Farm operators in segments chosen for the October 1 survey in one-half the counties were sent a mail questionnaire. Farm operators in the segments chosen for October 1 nonrespondent interviews in the other half of the counties were selected for the December 1 interview. This gave a mail inquiry sample of operators in one-fourth the segments and an interview sample of operators in one-eighth of the segments. Schedules were mailed on November 25 with a second request on December 1. The mail survey was closed on December 6. The interviewing was completed during the period of November 28 through December 3.

For livestock items separate estimates were made from the mail returns and the interview schedules using the percent change from June for identical farms. These estimates are given in tables 4.5, 4.6, and 4.7.

Table 4.5 - Percent of Fall intentions to farrow actually farrowed

Survey	Percent
December 1 mail survey	74
December 1 interview survey	72

Table 4.6 - Survey estimates of number of sows farrowed in Fall 1955 and to farrow in Spring 1956 compared with Board

Survey	Fall June 1,'55-Dec.1'56	Spring Dec. 1'55-June 1,'55
	1,000 head	
December 1 mail survey	857	1,166 1/
December 1 interview survey	662	927 1/
December 1 Board Pig Report	941	1,125

1/ No adjustment has been made for failure of actual farrowings to come up to reported intentions to farrow as indicated in table 4.6.

Table 4.7 - Survey estimates of number of hogs and cattle on hand Jan.1, '56 compared with Board

Survey	All hogs	All cattle
	1,000 head	
December 1 mail survey	8,805	23,360
December interview survey	7,874	26,768
Board	9,156	24,481

There is close agreement between the mail and interview surveys as to the fulfillment of fall intentions to farrow reported in June. Both surveys are lower than the Board on the number of sows farrowed during the period June 1 - December 1, 1955. If taken at face value the reported intentions to farrow in the spring of 1956 are higher than the Board in the mail survey but lower in the interview survey. Both surveys are lower if the intentions are discounted as might be indicated by table 4.5.

The estimate of all cattle on farms January 1 varied considerably in the two surveys. All States showed a downward trend in cattle numbers from June in the mail survey and the same was true for all States except Oklahoma in the interview survey. Apparently the increase in that State was due to purchases of cattle to run on wheat pastures.

In addition to the detailed questions on livestock, the December questionnaire asked for planted and harvested acres and production of corn and cotton as well as fall-planted acres of wheat. The data indicate that farmers generally report in December about the same acreage of cotton planted as in June but that by December they seem to forget about a large portion of the acreage of corn that was planted for purposes other than for harvest as grain. The wide variance in the cotton yield reported by mail and by interview is reduced somewhat by weighing the reported yield for each State by the June estimate of acreage. Such a weighing would indicate a yield of 333 pounds per acre for the mail survey and 419 pounds for the interview survey.

Both the mail and interview surveys indicated that farmers planted about the same acreage of wheat in the fall of 1955 as was planted a year earlier.

Table 4.8 - Percent of planted acreage harvested

Item	Cotton		Corn	
	Mail	Interv.	Mail	Interv.
	Percent	Percent	Percent	Percent
Dec. planted acres/June planted acres	98.8	99.5	92.0	85.6
Dec. harv. acres/June planted acres	92.0	97.1	75.4	76.1
Dec. harv. acres/Dec. planted acres	93.2	97.6	82.0	88.9
Dec. harv. for grain/June for harv. as grain	--	--	84.8	84.3

Table 4.9 - Yield per acre - December 1 survey, compared with Board

Item	Cotton	Corn
	pounds	bushels
Mail survey	466	26.6
Interview survey	302	28.0
December Board	380	28.4

No doubt a mail survey using an unbiased list of operators is more desirable than an uncontrolled mail survey but just how much better it is cannot be determined from the data we have. The smallness of the samples as well as the clustering, especially in the interview sample, make further testing necessary before valid conclusions can be made.

4.4 Summary and Recommendations

Apparently acreages of crops harvested or remaining for harvest can be obtained by using the mail survey plus non-respondent follow-ups. Yield per acre of cotton appears to be under-reported as of October 1. Yield per acre reported for other crops in October is slightly higher than December Board estimates. December estimates of yield for corn from the mail and interview surveys are close together

but differ widely for cotton. Extending the period of time of a survey sufficient to make mail inquiries and non-respondent follow-ups seems to be undesirable in the case of livestock surveys because of the rapid change in inventories in late November and December.

Although no conclusive case can be made against mail surveys and non-respondent follow-ups as such, the research staff, for a number of reasons, believes that a fall survey to determine acreage and production and a December survey to obtain information on the pig crop and livestock numbers should both be interview surveys. They should be made on a larger subsample of the June survey than was used in 1955. Some of the reasons are:

(1) An acreage and production survey can be integrated with the final pre-harvest objective yield measurements for cotton, corn, and other important crops; and a December livestock survey can be combined with a post-harvest yield survey.

(2) Unit costs can be lowered by combining A and P and livestock surveys with objective yield surveys.

(3) Such a combination of surveys provides for better use of field personnel.

(4) Interview surveys can be made in less time than is required to mail out inquiries and make non-respondent interviews.

(5) The data from interview surveys are susceptible to statistical analysis.

5. Objective Yield Surveys

5.1 Purpose

This phase of the research program is aimed at developing methods of forecasting yields from plant characteristics. These studies have been confined to cotton, corn, and winter wheat. The winter wheat work actually constituted only a small exploratory project in the spring of 1955 and results have not been reported previously. The results of last year's work on cotton and corn indicate that this is a feasible approach to forecasting and estimating yields for these crops.

The basic philosophy underlying these surveys is to obtain plant data as of specified dates and to translate them into yield forecasts applicable to those dates. Four surveys were conducted for both cotton and corn. The first three were to provide objective plant data. The farmers' yield forecast was also obtained on the first survey. The fourth survey was conducted to obtain data on the amount of the crop left in the field after the farmer had completed his harvesting operations and to get the farmer's estimate of production.

For winter wheat only three surveys were scheduled. Each survey was to provide objective plant data, or post-harvest gleaning data if the sample field was found to be harvested. In addition, the farmers' yield forecast was obtained on the first survey and his report of harvest production on the last survey.

After the questionnaires from the June 1955 survey in the 10 Southern States were tabulated, two subsamples of 200 cotton farms and 200 corn farms were selected; two fields on each of those farms were used for plant observations and other detailed information on the 1955 crop. These surveys were scheduled as of August 1, September 1, October 1, and December 1. For winter wheat, questionnaires from the December 1, 1954 survey in Texas and Oklahoma were tabulated and a subsample of farms drawn for plant observations and other data on about 60 fields. These surveys were scheduled as of May 1, June 1, and July 1, 1955.

The cotton and corn work in 1955 differed in several respects from that in 1954:

1. The first corn survey was moved up a month to coincide with the first cotton survey in late July. The 1954 experience indicated that corn is too advanced by September 1 in the South to study forecasting problems in early stages of the crop. Combining the cotton and corn surveys for all three months is also believed to result in a more efficient use of personnel.

2. A third cotton survey was introduced on October 1 to study the extent to which September 1 fruit counts changed during the month.

3. The fruit on selected hills of cotton was tagged to permit tracing the development of individual blooms and bolls during the growing season.

4. In an effort to reduce costs, one-man sampling teams were used to the extent possible after the first survey on August 1.

5. The number of fields in the sample was doubled.

6. Two cotton (or corn) fields were chosen on each selected farm to study the variability between fields on the same farm. This seemed desirable because visiting a farm represents a high proportion of the cost as compared with other phases of the field work.

7. Post-harvest data on both cotton and corn were obtained as required during the three scheduled surveys; a special December 1 survey provided similar data for late maturing fields. In 1954 the post-harvest data were obtained in a special survey which depended upon the date of harvest on each farm. Operationally, this procedure was expensive and required the constant attention of field supervisors and workers for an extended period.

8. The plots selected for plant observations within fields were permitted to fall at random in all sections of the fields by the use of predetermined row and pace numbers for fields of various sizesand shapes. In 1954 a systematic procedure was used.

5.2 Cotton Yield Surveys

The sample farms constituted a subsample of the farms with cotton which were enumerated in the June 1955 Interview Survey. The sample farms were drawn with probabilities proportional to cotton acreage by accumulating the acres of cotton "operated" by each respondent to the June Survey and selecting the farms containing every nth acre of cotton, where n equals the sampling interval. The sampling interval was about 135 acres in the non-wheat counties and about 385 acres in the wheat counties. Two sample fields were selected on each sample farm. The selection of the sample fields was made from information on individual field acreages obtained as part of the farm interview. A random number corresponding to each field to be selected

was entered on the questionnaires provided the enumerator. These two numbers were between 1 and the total number of acres of cotton planted on the farm; the first was a random number, the second was that number increased by a sampling interval equal to one-half the cotton a erage on the farm. Occasionally a field was selected more than once, if its acreage exceeded one-half of the total acres on the farm. Carrying the above procedure through in all States resulted in a sample of farms and cotton fields selected with probabilities proportional to reported cotton acreage. The farms and fields were distributed among the 10 States as shown in table 5.1.

Table 5.1 - Number of sample farms and cotton fields by States

State	Selected		Field counts made August 1	Field counts made Sept. 1	Field counts made Oct. 1	Post-harvest gleaning made
	Farms	Fields				
Ala.	13	28	28	28	28	23
Ark.	18	44	44	38	44	2
Ga.	8	16	16	16	16	12
La.	7	18	18	18	18	2
Miss.	21	44	40	42	44	26
N. Car.	4	8	8	8	8	4
Okla.	14	28	28	28	28	26
S. Car.	10	20	20	20	20	8
Tenn.	9	18	18	18	18	8
Texas	83	176	174	174	153	61
10 States	187	400	394	390	377	172

August 1 Survey: The farmer was interviewed to obtain data on cotton acreage and expected production. Data relating to the farm unit as a whole are given in table 5.2.

Table 5.2 - August 1 farm interview data

Item	Unit
1. Yield per acre forecast	323 pounds of lint
2. June acreage for harvest	97.8 percent
3. Fields per farm	4.0 number

The forecast of yield per acre for the farm was derived from the estimator:

$$(1)\quad \bar{Y} = \frac{480}{n} \sum_{i=1}^{n} \frac{pi}{Ai}$$

The other two items in table 5.2 were computed from:

$$(2)\quad \text{R acres for harvest} = 100 \frac{\sum_{i=1}^{n} A_i}{\sum_{i=1}^{n} A_{pi}}$$

$$(3)\quad \bar{K} = \frac{\sum_{i=1}^{n} K_i}{n}$$

P_i = expected production in bales on i^{th} farm (field) August 1

A_i = expected acreage for harvest on i^{th} farm August 1

A_{Pi} = reported acres planted or to be planted in June for i^{th} farm

480 = pounds of lint in a bale

K_i = number of fields on i^{th} farm August 1

n = number of farms in sample

The first sections of the farm interview questionnaire (Form A) were a quality check on the June Survey to see if operators had been properly identified and tenants properly classified. Two sets of questions were used; one for farms reporting tenants in June and another for farms not reporting tenants in June.

The sample cotton fields were selected and detailed plant observations made on those fields. Table 5.3 shows the average acres of cotton reported for all farms in June and for the subsample of cotton farms and fields.

Table 5.3 - Acres of cotton per farm and field

Unit and Item	Acres of cotton planted and to be planted
Per farm	
All farms in June survey	10.2
All farms reporting cotton in June survey	23.3
Sample farms in yield survey	72.9
Per field	
All fields for farms in yield survey	18.8
Sample fields in yield survey	35.1

The information given by the grower for the sample fields is summarized in table 5.4.

Table 5.4 - Interview data for sample fields

Item	Unit
1. Initial report of acres of cotton in field	35.1 acres
2. Acres of cotton in field less borders, ditches, terraces and other areas not in cotton	35.0 acres
3. Yield per acre	335 lbs. of lint
4. Crop harvested to date	3.7 percent

Item (4) is given by: $100 \frac{\sum_{i=1}^{n} P_{hi}}{\sum_{i=1}^{n} P_{i}}$ where P_{hi} = harvest production in bales on i^{th} farm as of Aug. 1.

The Crop Reporting Board's August 1 yield forecast for the same 10 States was 329 pounds of lint per acre as compared to 323 pounds reported for the farm as a unit and 335 pounds reported for the sample fields. The tendency of growers to report a higher yield for the sample fields than for the farm as a whole is similar to results obtained in the 1954 surveys.

Field Observations: Two sample plots were selected in each sample field (or each time the field was selected, if selected more than once). Each plot consisted of two parallel 10-foot row sections in adjacent rows. Detailed fruit counts were made for the last hill in each row inside the unit and for the second hill beyond the unit for one unit in each field. The plot locations were established by classifying each field as either square or rectangular. From the field size and shape information, the samplers selected row and pace numbers from a Plot Selection Sheet. A different set of row and pace numbers was used for each field. The row and pace numbers entered on the Plot Selection Sheets were determined as follows:

1. For the first unit in one half of the fields, the row and pace numbers were determined by selecting random numbers between 1 and the maximum number of rows or paces for a field of that shape and approximate size shown on the Plot Selection Sheet. The row and pace coordinates for the second unit were obtained by adding 30 to those for the first unit.

2. For the first unit in the other half of the fields, the row and pace numbers were determined as follows:

   (a) In one-fourth of the fields, random numbers were selected between 1 and 20 to determine the row and pace coordinates to locate the first unit.

   (b) In three-fourths of the fields, random numbers were selected between 21 and 40 to determine the row and pace coordinates to locate the first unit.

   (c) In each case the row and pace coordinates for the second unit were obtained by adding 30 to those determined for the first unit.

The row and pace coordinates for 1 were assigned to the odd numbered lines on the Plot Selection Sheets and those for group 2 were assigned to the even numbered lines. The purpose of the two location schemes was to learn whether counts on random units and on units selected by an artitrary rule differ significantly. After the row and pace corrdinates were selected, the first corner reached in approaching the field was marked with a large stake. The required number of rows and paces were reached by counting from this corner. Each field was also classified as being on or off a road on the county highway map.

The following information was obtained for each 10 feet of row.

1. Counts for entire 10-foot row sections

   (a) Number of hills or plants

   (b) Number of burrs, open bolls, and large unopened bolls (1" or more in diameter)

   (c) Width across 4 row spaces

2. Counts on plant for last hill (or plant) in each 10-foot row section of unit one

   (a) Number of burrs and open bolls

   (b) Number of large unopened bolls

   (c) Number of small bolls

   (d) Number of blooms

   (e) Number of squares

   (f) Number of plants in hill

After the counts were made, small red merchandising tags were looped around the stems of fruit (a) and (b), and small yellow tags were looped around the stems of fruit (c) and (d).

3. Stripped counts(picked fruit) for second hill (or plant) beyond each 10-foot row section of unit one.

(a), (b), (c), (d), (e), and (f) as in 2; in addition, a count of fruit in (a), (b), (c), (d), and (e) damaged from any cause. For(a) and (b) the total number of locks and damaged locks were counted. The data are summarized in tables 5.5, 5.6, and 5.7.

Table 5.5 - August 1 field observations

Item	1954	1955
1. Burrs, open bolls, and large unopened bolls (1" or more) per 40 ft. row (number)	89.0	90.3
2. Width across 4 row spaces (feet)	27.8	27.7
3. Field location with respect to public roads:		
(a) On roads (percent)		54
(b) Off roads (percent)		46
4. Most advanced stage of fruiting (maturity):		
(a) Large boll stage (percent of fields).....	53.8	75.1
(b) Small boll stage (percent of fields).....	16.7	15.7
(c) Bloom stage (percent of fields).....	4.6	2.7
(d) Square stage (percent of fields)	24.9	6.5

Table 5.6 - August 1 fruit counts per 40 ft. of row by categories

Kind of fruit	1954	1955
	(Number)	(Number)
Burrs and open bolls.....	11.6	7.6
Large unopened bolls.....	78.7	73.8
Small bolls	76.5	68.7
Blooms	38.3	25.3
Subtotal	205.1	175.4
Squares	314.0	339.5
Total Fruit	519.1	514.9

Table 5.7 - August 1 observations on percent damage

Item	1954	1955
	Percent	Percent
Locks in burrs, open bolls and large unopened bolls.....	4.1	6.4
Burrs, open bolls, and large unopened bolls.....	-	10.7
Small bolls.....	5.7	13.0
Blooms.....	-	5.2
Squares.....	-	5.4

The average on-plant counts for plants inside the unit are compared with stripped counts, where the fruit was picked before counting, on plants beyond the end of the unit.

Table 5.8 - August 1, 1955 average fruit counts per 2 hills by two methods of counting

Kind of fruit	Method of counting	
	On plant	Picked
	Number	Number
Burrs, open bolls, and large unopened bolls.....	5.73	5.39
Small bolls.....	4.41	4.97
Blooms.....	1.64	1.82
Squares.....	23.01	23.38
Total.....	34.79	35.56

The total count is about 2.2 percent greater for hills stripped or picked before counting.

September 1 Survey: The fields and plots in which counts were made a month earlier were revisited. The samplers proceeded directly to the sample fields and made the required observations in the same manner as a month earlier, except for modifications corresponding to the more advanced maturity stage. For tagged plants, it was also necessary to tag any large bolls, small bolls or blooms which did not have tags. Open cotton was picked and weighed with a large handful of seed cotton from each row being placed in a moisture-proof bag and and carried back to the office. These small samples were weighed en masse for each sampler at the State office before the cotton was removed from the bags. The composited samples were spread out to dry at room temperature for a week or so, and reweighed to determine the moisture loss.

For fields on which harvest had been completed, the sampler carried out the post-harvest gleaning operations and interviewed the grower to obtain his estimate of harvested production. The data are summarized in tables 5.9, 5.10, 5.11, 5.12.

Table 5.9 - September 1, 1955 fruit counts and cotton weights for two 10-foot double row units

Item	1954	1955
1. Number of hills (or plants).....	37.8	39.1
2. Number of burrs, open bolls and large unopened bolls.....	226.5	233.8
3. Number of open bolls picked.....	37.6	21.1
4. Field weight of seed cotton picked (grams).....	190.7	120.5
5. Field weight of seed cotton per boll (grams).....	5.07	5.71
6. Ratio of air-dried weight to field weight	.925	.896

Table 5.10 - September 1 fruit counts per 40 foot row by categories

Kind of fruit	1954	1955
1. Number burrs and open bolls	53.5	48.4
2. Number of large unopened bolls	173.0	185.4
3. Number of small bolls	39.5	78.5
4. Number of blooms	8.8	20.3
Subtotal	274.8	332.6
5. Number of squares	-	155.6
Total fruit	-	488.2

Table 5.11 - September 1 observation on percent damage

Item	1954	1955
	Pct.	Pct.
Locks in burrs, open bolls and large unopened bolls	5.8	9.2
Burrs, open bolls, and large unopened bolls	-	16.5
Small bolls	16.1	21.6
Blooms	-	9.0
Squares	-	17.3

Table 5.12 - September 1, 1955 fruit counts for 2 hills by two methods of counting

Kind of fruit	Method	
	On plant	Picked
	Number	Number
Burrs, open bolls and large unopened bolls	16.2	16.0
Small bolls	5.2	5.6
Blooms	1.4	1.4
Squares	10.8	10.6
Total	33.6	33.6
Plants per hill	1.63	1.62

Some comparisons of tagged counts for August 1 and September 1 are given in tables 5.13 and 5.14. The main purpose of tagging was to estimate the rate of survival for various classes of fruit between the two months.

Table 5.13 - September 1 counts of tagged fruit and source of fruit as indicated by August 1 counts 1/

September 1		August 1 classification		
Fruit classification	Number counted	Burrs, open bolls or large unopened bolls	Small bolls or blooms	Squares
		Number	Number	Number
Burrs and open bolls	1,101	1,058	52	--
Large unopened bolls	4,877	741	1,224	2,921
Total large bolls	5,978	1,799	1,276	2,921
Small bolls	1,985 2/	--	93	1,902
Blooms	555	--	--	--
Squares	4,166	--	--	--
Total counted Sept. 1	12,684	1,799	1,369	4,823
Total counted Aug. 1	13,196	1,951	2,364	8,958

1/ Excludes those fields harvested between August 1 and September 1.

2/ A small fraction of these bolls may have come from squares formed after August 1.

The next to the last line in table 5.13 indicates the relative importance of each of the August 1 sources in producing fruit counted on September 1. The bloom and squares counted on September 1 were all formed from fruit not yet present by August 1. Rates of survival for fruit in each category are given in table 5.14, according to the maturity of the field on August 1.

Table 5.14 - Survival of fruit between August 1 and September 1 by field stage of maturity on August 1 1/

August 1 Classification of fruit	August 1 stage of maturity of field				All Groups
	Large bolls present	Small bolls blooms and squares present	Blooms and squares present	Only equares present	
	Percent	Percent	Percent	Percent	Percent
Large bolls.....	92.2	--	--	--	92.2
Small bolls and blooms..	50.7	82.6	83.3	--	57.9
Squares.....	42.2	72.8	80.1	83.7	53.8
Number of fields.....	189	63	18	95	365

1/ Excludes fields harvested between August 1 and September 1.

October 1 Survey: Fields and plots in which counts were made the two previous months were revisited. The samplers proceeded directly to the sample fields and made similar observations, except for modifications corresponding to stage of maturity. The main purpose of this survey was to determine the extent of late fruiting and to obtain post-harvest gleaning data in early-harvested fields. The data are summarized in tables 5.15, 5.16, and 5.17.

Table 5.15 - October 1, 1955 fruit counts and cotton weights for two 10 foot double row units

Item	Unit
1. Number of hills	45.1
2. Number of burrs, open bolls and large unopened bolls	294.7 1/
3. Number of open bolls picked	111.2
4. Field weight of seed cotton picked (grams)	621.3
5. Field weight of seed cotton per boll (grams)	5.59
6. Ratio of air-dried weight to field weight (percent)	90.0

1/ The corresponding count for the previous month was used for fields where harvest was completed.

Table 5.16 - October 1 counts of tagged fruit and sources of fruit as indicated by September 1 counts

October 1 Classification of fruit	Counted September 1			Formed after Sept. 1	Total
	Red	Yellow	Non-tagged		
	Number	Number	Number	Number	Number
Burrs, open bolls and large unopened bolls	3,597	1,987	599	--	6,183
Small bolls	--	97	153	--	250
Blooms	--	--	--	14	14
Squares	--	--	--	563	563
Total October 1	3,597	2,084	752	577	7,002
Total September 1	4,557	3,688	4,045	0	12,684 1/

1/ Excludes fields harvested before September 1.

Table 5.17 - Source of large bolls set through October 1

Item	Sources			Total large bolls set
	Large bolls	Small bolls & blooms	Squares	
	Number	Number	Number	Cumulative number
Counted on August 1	2,323			2,323
Picked or lost during Aug. ..	- 524			
Added during August	0	1,276	2,921	6,520
Picked or lost during Sept. .	-1,025	- 94		
Added during September	0	711	599	7,830
Total set on or after Aug. 1	2,323	1,987	3,520	7,830

Table 5.18 - Percent of small bolls, blooms, and squares counted on August 1 and Sept. 1 reaching large-boll category by October 1 1/

Class of fruit	August 1	September 1
	Percent	Percent
Small bolls and blooms	54.0	56.5
Squares	32.6	14.8

1/ Excludes fields completely harvested before September 1.

Post-Harvest Survey: The sample farms were to be visited after final production data were available. This survey was not tied to any specific date, but was to coincide with the first visit on which the field was found to be harvested on or before October 1. For fields which were not harvested by October 1, a final visit was made to a sample of fields around December 1 to obtain gleaning data for harvested fields and the growers' reported production. Two new plots were staked out in the same section of the field for obtaining the gleaning data.

Farm Interview Data: The farm interview was used to obtain final production data for the farm as a whole, together with more detailed information for the sample field(s). On those farms where some of the crop was still to be picked, the operators' estimate of cotton harvested and to be harvested was obtained. For each farm the grower was asked if the basis for his reported production was the total of his gin tickets or his best estimate based on his recollection of the amount ginned. In a majority of cases, growers actually totaled their gin tickets in the presence of the enumerator to obtain the production data.

Table 5.19 - Interview data

Item		Units
Farm unit items:		
1. Yield per acre	343	pounds of lint
2. July acreage harvested	98.7	percent
3. Crop harvested to date	94.6	percent
4. Weight per bale	465	pounds
Sample field items:		
5. Yield per acre	332	pounds of lint
6. July acreage harvested	98.9	percent
7. Growers' estimate of cotton per acre remaining in field after harvest	23.5	pounds

Field Gleaning Data: Observations were taken on two double 10-foot row sections as in previous surveys. In addition to a count of bolls, all seed cotton was placed in a bag and taken to the State office where it was airdried and its weight determined. These data are summarized in table 5.20. Separate figures are shown for fields that were harvested prior to October 1 and for those harvested after October 1.

Table 5.20 - Average counts and weights for two field units (Post-harvest)

Item	Harvest prior to Oct. 1	Harvest after Oct. 1	Weighted average
Number of fields	138	255	--
Number gleaned	91	81	--
Number open bolls	31.8	12.4	19.7
Number large unopened bolls	0.6	3.4	2.5
Number rotten bolls	25.0	12.5	17.5
Weight of seed cotton in open bolls (grams)	72.5	28.9	44.2
Weight of loose seed cotton (grams)	57.6	16.9	31.4
Total wet weight of seed cotton (grams)	130.1	45.8	75.6*

* Dry weight of cotton 64.7 grams.

In the gleaning operation 64.7 grams of seed cotton were found. If the unopened and dried bolls are assumed to have had the same seed cotton potential as the open bolls, the total losses per field would be (19.7 + 20.0) (64.7/19.7)= 130.4 in terms of grams of seed cotton. This weight of seed cotton is equivalent to 90.2 pounds of seed cotton per acre or 33.4 pounds of lint per acre. This is 8.6 percent of the total potential indicated on October 1. The corresponding loss for 1954 was 9.0 percent.

5.3 Corn Yield Surveys

A subsample of the farms reporting corn in the June 1955 acreage survey was selected for the yield forecasting studies. The subsample of farms was drawn with probability proportional to the corn acreage "operated" by each respondent to the June Survey. Two sample "fields" were selected on each farm as for cotton; however, the sampling intervals used were slightly smaller. Sample fields and plots with fields were selected by the same procedures as for cotton. The distribution of farms and fields among the 10 States was as shown in table 5.21.

Table 5.21 - Number of sample corn farms and fields by States

State	Selected		Field counts made August 1	Field counts made September 1	Field counts made October 1	Preharvest gleanings made
	Farms	Fields				
Ala.	26	52	52	52	49	39
Ark.	8	16	14	14	12	0
Ga.	32	72	67	65	22	33
La.	6	12	10	10	6	6
Miss.	28	56	47	52	52	7
N. Car.	24	48	44	43	35	13
Okla.	2	4	2	9	2	2
S. Car.	17	38	36	37	30	5
Tenn.	23	48	48	46	43	12
Texas	27	54	52	52	4	23
10 States	193*	400	372	373	255	140

* A farm may be sampled more than once if the acreage exceeds the sampling interval.

August 1 Survey: The farmer was interviewed to obtain data on corn acreage for grain and expected production. Data relating to the farm unit as a whole are given in table 5.22.

Table 5.22 - Farm interview data

Item	Unit
1. Planted acres still standing	96.0 percent
2. August 1 acres for harvest as grain	91.5 percent
3. Yield per acre forecast (for grain)	32.4 bushels
4. Fields per farm	4.9 number

The average acres of corn reported for all farms and for the subsample of cotton farms and fields are given in table 5.23.

Table 5.23 - Acres of corn per farm and field

Unit and item	Acres of corn planted and to be planted
Per farm	
All farms in June Survey	10.8
All farms reporting corn in June Survey	17.2
Sample farms in yield survey	51.2
Per field	
All fields for farms in yield survey	8.8*
Sample fields in yield survey	14.4*

* Acres for grain

The information given by the grower for the sample fields is summarized in table 5.24.

Table 5.24 - Interview data for sample fields

Item	Unit
1. Initial report of acres of corn in field	17.4
2. Acres of corn in field less borders, ditches, terraces and other areas not in corn	16.5
3. Net acres for grain	14.4
4. Yield per acre for grain	32.1

The Crop Reporting Board's August 1 yield forecast for the same 10 States was 26.8 bushels per acre. The tendency of growers to report higher yields for the sample fields as compared to the farms as a whole was not found. The fact that practically all the fields on the farm were included in the yield survey probably result in the grower's yields for that farm unit and field unit being the same.

Field Counts and Observations: Two sample plots were selected in each sample field (or each time the field was selected, if selected more than once). Each plot consisted of two parallel adjacent 15-foot row sections. Detailed observations on stage of maturity were made on the first 5 ears beyond row 1 of unit 1. The plot locations were established by the same procedure as for cotton (see page 31). Each field was also classified as being on or off a road on the county highway map.

The following information was obtained for each 15-foot of row.

1. Counts for entire 15-foot row sections
   a. Number of stalks
   b. Number of stalks with ears
   c. Number of ears
2. Data for row 2 of unit I
   a. Length of cob (determined in husk)
   b. Diameter of ear (determined in husk)
   c. Number of ears not expected to produce grain
3. Determination for first 5 ears beyond row 2, unit I
   a. Percent fill for each ear
   b. Stage of maturity for each ear

The counts and data obtained in 1, 2, and 3 are summarized in tables 5.25, 5.26, and 5.27.

Table 5.25 - Average counts and row spacing for two 15 feet of double row, August 1, 1955

Item	Two units
1. Number of stalks	27.6
2. Number of stalks with ears	20.9
3. Number of ears (silked)	30.8
4. Width across 8 row spaces (feet)	27.8

Table 5.26 - Average counts and ear measurements for row 2 of unit I, August 1, 1955

Item	Average
1. Number of ears	7.17
2. Length of ear in husk (inches)	6.85
3. Circumference of ear in husk (inches)	5.95
4. Number of ears not expected to make grain	.75

Table 5.27 - Percent fill and stage of maturity for 5 ears beyond row 2 of unit I, August 1, 1955

Item	Percent
1. Area of cob filled with grain	60.1
2. Stage of maturity of ears:	
Mature	4.6
Dent	25.0
Dough	10.4
Milk	18.1
Earlier than milk	26.8
No ears formed	15.1

September 1 Survey: The same fields and plots which were selected amonth earlier were revisited. The counts and observations were the same as a month earlier except where fields were mature. In mature fields the plots were harvested, and four sample ears sent to the State office for laboratory observations. Detailed ear characteristics were also obtained for the ears submitted for moisture testing. When the field was found to be already harvested, the sampler carried out the post-harvest gleaning operations. The data are summarized in tables 5.28, 5.29, and 5.30.

Table 5.28 - Average counts for two 15 feet of double row, September 1, 1955

Item	Average
1. Number of stalks	27.6
2. Number of stalks with ears	25.1
3. Number of ears (silked)	33.6

Table 5.29 - Average counts and ear measurements for row 2 of unit 2, September 1, 1955

Item	Average
1. Number of ears	8.51
2. Length of ear in husk (inches)	6.75
3. Circumference of ear in husk (inches)	6.23
4. Number of ears not expected to make grain	.61

Table 5.30 - Percent fill and stage of maturity for 5 ears beyond row 1 of unit 1, September 1, 1955

Item	Percent
1. Area of cob filled with grain	81.7
2. Stage of maturity of ears:	
Mature	32.6
Dent	40.3
Dough	12.3
Milk	7.1
Earlier than milk	7.7

October 1 Survey: In late September the sampling teams revisited the same fields and plots which were laid out for the August 1 Survey. The grower was not contacted unless the field was already harvested. The stalk and ear counts were the same as for earlier months. In addition, all corn for the sample plots was picked and weighed. Four ears from each field were selected and placed in moisture-proof bags for moisture determinations and other laboratory observations. If the field had already been harvested, the samplers carried out the post-harvest gleaning procedure (Form E) and interviewed the grower if he was readily available (Form D).

Tables 5.31, 5.32, and 5.33 summarize the data obtained in those fields where preharvest samples were obtained. Table 5.34 summarizes data on corn picked and weighed in the sample plots during the three surveys.

Table 5.31 - Counts and weights for two 15 feet of double row, October 1, 1955.

Item	Average
1. Number of stalks	28.6
2. Number of stalks with ears	25.2
3. Number of ears	32.0

Table 5.32 - Average counts and ear measurements for row 2 of unit 2, October 1, 1955

Item	Average
1. Number of ears	8.39
2. Length of ear in husk (inches)	6.55
3. Circumference of ear in husk (inches)	6.35
4. Number of ears not making grain	.23

Table 5.33 - Percent fill and stage of maturity for 5 ears beyond row 1 of unit 1, October 1, 1955

Item	Percent
1. Area of cob filled with grain	80.9
2. Stage of maturity of ears:	
Maturity	91.5*
Dent	6.6
Dough	1.6
Milk	.3

* Of this total, 31.1% was harvested prior to Oct. 1.

Table 5.34 - Average weight of corn harvested from sample units by survey date, per 60 foot row

Item	Survey			For
	Aug. 1	Sept. 1	Oct. 1	Season
Number of fields	13	87	284	384
Number of ears with grain	37.9	28.9	30.8	30.6
Field weight of ear corn (lbs.)	14.0	11.3	12.3	12.1*

* Moisture content 19.2%.

Post-Harvest Survey: The sample corn farms were visited after final production data were avialable. However, the growers' reported production was based on a count of wagon loads or other approximate measures of bushels rather than actual weighings of corn. The farm interview data are summarized in table 5.35.

Table 5.35 - Interview data

Items	Units
Farm unit items:	
1. Yield per acre	29.1 bushels of shelled corn
2. July acreage harvested for grain	95.2 percent
3. Crop harvested to date	73.6 percent
Sample field items:	
4. Yield per acre	29.2 bushels of shelled corn
5. July acreage harvested for grain	92.7 percent
6. Growers' estimate of corn per acre remaining in field after harvest	1.15 bushels of shelled corn
7. Method of harvesting:	
a. Machine picked	34.1 percent
b. Hand pulled	55.2 percent
c. Hand picked	10.7 percent
From stalk	(9.7) percent
From shock	(1.0) percent
8. Grazed after harvested for grain	37 percent

Field Gleaning Data: Observations were taken on two double 15-foot row sections as in previous surveys. These plots were located 5 rows farther into the field than those used earlier. The number of ears, weight of ears and weight of grain were determined separately for the plants and the "middle" associated with each row. These data are summarized in table 5.36.

Table 5.36 - Average counts and weights for two field units

Item	Harvest prior to October 1		Harvest after October 1		Weighted average	
Number of fields	127		255		--	
Number gleaned	75		65		--	
	On plant	On ground	On plant	On ground	On plant	On ground
Number of ears	1.5	1.3	1.7	1.4	1.6	1.4
Weight of ears (grams)	94.1	101.9	100.1	139.0	98.1	136.7
Weight of grain from ears (grams)	75.0	78.7	77.6	109.1	76.7	99.0
Weight of loose kernals	--	36.4	--	22.2	--	26.9
Total weight of all grain (grams)	75.0	115.1	77.6	131.3	76.7*	125.9*

* Moisture content 16.37% - total weight 200.6 grams at 15.5%.

The extent to which grain may have been consumed by animals is not known. The indicated harvesting loss is 1.65 bushels per acre.

$$\text{Bushels per acre} = \frac{(\text{Weight of grain in grams})\ (\text{Square feet in acre})}{(\text{Length of row})\ (\text{Row width})\ (\text{Pounds in bushel})\ (\text{Grams in pound})}$$

$$\text{Bushels per acre} = \frac{(200.6)\ (43560)}{(60)\ (3.475)\ (56)\ (453.59)} = 1.65$$

This is 3.8 percent of the gross weight (or yield) indicated by the sample plots.

5.4 Winter Wheat Yield Surveys

A subsample of the farms was selected from the December 1, 1954 mail and interview surveys in Texas and Oklahoma. The subsample of farms was allocated to the mail and nonrespondent strata in proportion to the total acres of wheat in each group. The first survey was scheduled for the week of April 25 and related to a May 1 forecast date. This survey consisted of an interview with the farm operator and observations for small field plots in 60 fields on the selected farms. The actual selection of the sample fields was made from information on individual field acreages obtained as part of the farm interview. The procedure of selecting fields was the same as used for cotton and corn. The farms and fields were distributed between Texas and Oklahoma, as shown in table 5.36.

Table 5.36 - Number of sample wheat farms and fields

State	Selected		Field counts made 5/1	Field counts made 6/1	Field counts made 7/1	Post-harvest gleaning made
	Farms	Fields				
Oklahoma	20	31	26	26	10	10
Texas	16	29	11	11	3	2
Total	37	60	37	37	13	12

May 1 Survey: The operator was interviewed to obtain data on wheat acreage and expected production. While 60 fields were selected from the growers' planted acreage for grain, heavy abandonment resulted in only 37 fields remaining for harvest as of May 1. Results of the May 1 interview data are summarized in table 5.37.

Table 5.37 - Farm interview data

Item	Unit
Acres planted	269.8 acres per farm 1/
Acres for harvest	100 acres per farm
Yield per acre for entire farm	6.25 bushels
Yield per acre for sample fields	7.98 bushels

1/ The average as reported on the December 1, 1954 survey was 273.9 acres.

Two sample plots were selected in each sample field (or each time the field was selected, if selected more than once). Each plot consisted of three adjacent drill rows 26.136 inches long. The plot locations were established after classifying each field as either square or rectangular. From the field size and shape information, the samplers selected a set of pace numbers from a Plot Selection Sheet. A different set of pace numbers was used for each field. The pace numbers were obtained in the same manner as for cotton and corn (page 31). The location of the first plot in each field was determined from a pair of pace numbers by starting at the field corner and walking along the edge of the longer side of the field, taking the number of paces indicated by the first number, then turning at a right angle and taking the number of paces into the field indicated by the second number. Opposite the toe of the sampler's foot on the last of the required paces into the field, the sampler laid a yard stick perpendicular to, or across the first three drill rows just beyond his toe or on his right if he was walking parallel to the rows. A U-shaped frame was slipped through the grain so the form of the plot corresponded to the position of the yard stick. The frame controlled only the length of the rows except in the case where 3 drill rows could not be distinguished and the plot consisted of all the stalks inside the area of the U-shaped frame. The second plot in each field was located 30 paces farther along the edge and into the field in the direction the sampler had been walking when he arrived at plot 1. Each field was classified as being on or off a road on the county highway map.

The following information was obtained for each 3-row plot.

1. Counts for 3 rows

   a. Number of stalks
   b. Number of heads
   c. Height of stalks

2. Counts for row 1

   a. Number of stalks showing infestation or damage

3. Stage of maturity of each plot

4. Head samples for laboratory

   a. "Ripe" or "hard dough" stage - clip (all heads in unit)
   b. "Soft dough" or "milk" stage - clip last (5 heads from each row)

Table 5.38 summarizes the counts for the May 1 Survey.

Table 5.38 - Average May 1 field counts per 6.53 foot row

Item	Stage of maturity		All fields
	Milk or soft dough	Earlier milk	
Number stalks	129.5	101.3	102.0
Number stalks showing evidence of damage	0.0	1.1	1.1
Number heads	50.0	6.7	7.9
Height of tallest stalk at end of unit	28.3"	7.7"	8.3"
Date planted	10/15/54	10/11/54	10/11/54
Width across 10 row spaces	6.35'	7.72'	7.59'
Number fields	1	36	37
Number of fields abandoned			23

June 1 Survey: The same fields were visited again the last week in May. The samplers proceeded directly to the sample fields and laid out new plots, 5 paces farther along the edge and into the field. The required observations were the same as a month earlier except for modifications in obtaining head samples due to the more advanced maturity stage. The data are summarized in table 5.39.

Table 5.39 - Average June 1 field counts per 6.53 foot row

Item	Stage of maturity			All fields
	Ripe or hard dough	Soft dough or milk	Earlier milk	
Number stalks	85.1	105.8	98.1	99.6
Number stalks showing evidence of damage	3.2	4.2	0.4	2.9
Number heads	68.7	75.7	19.9	57.8
Height of tallest stalk at end of unit	15.4"	17.0"	10.8"	14.9"
Date planted	10/17/54	10/8/54	10/12/54	10/11/54
Width across 10 row spaces	5.81'	7.03'	9.35'	7.59'
Number fields	7	19	11	37

July 1 Survey: The same fields were revisited, but new plots were located 5 paces farther along the edge and into the field. In the event the field was harvested, the post-harvest gleaning operations were carried out. The operator was interviewed in each case to obtain his production for the farm and each sample field. In cases where the harvest was not complete, the growers' estimate of expected production was obtained.

Table 5.40 summarizes the data for fields which had not been harvested. Tables 5.41 and 5.42 summarizes the July 1 interview data and post-harvest gleaning data.

Table 5.40 - July 1, interview data

Item	Unit
Acres intended for harvest, May 1	100 acres
Acres harvested	87.6 acres
Yield per harvested acre for farm	8.56 bushels
Yield per harvested acre for fields	8.66 bushels
Yield per planted acre for farm	5.13 bushels
Yield per planted acre for fields	4.34 bushels

Table 5.41 - Post-harvest gleaning data

Item	Unit
Number fields plowed up or wheat destroyed..	17 number
Number fields not yet harvested.....	8 number
Number fields in which gleanings obtained....	12 number
Number whole heads (per 13.1 ft. row).....	17.5 number
Weight of whole heads and broken heads found (per 13.1 ft. row).....	10.7 grams
Weight of grain found (per 13.1 ft. row).....	5.89 grams
Moisture content of grain.....	12.3 percent
Grain per acre.....	1.0 bushels

The results of the laboratory determinations on the head samples are given in table 5.42, below.

Table 5.42 - Laboratory data for fields in milk stage or later

Item	Stage of maturity		
	Milk	Soft dough	Ripe or hard dough
Wet weight per head.....	.659	.731	0.449 grams
Length per head (excluding beards).....	2.16	1.99	1.96 inches
Weight of threshed grain per 13.1 ft. row	-	-	40.3 grams
Moisture content.....		-	15.2 pct.
Yield of grain per acre		-	7.2 bshls.1/
Number of fields.....	11	14	10

1/ At 13.5 percent moisture content but not adjusted for harvesting losses.

5.5 Discussion and Analysis of Yield Data

Cotton: Three distinct approaches were considered in formulating forecasting procedures or models using the fruit counts from the 1954 surveys. The three approaches considered were: (1) the multiple regression approach, (2) a "probability of survival" model, and (3) an empirical approach. Yield forecasting studies in 1955 were tested under vastly different growing conditions; 1954 was very dry and 1955 was very wet. The cotton plants had not reached as advanced a stage of maturity by August 1, 1955 as they had attained by August 1, 1954. Consequently, a heavier increase in the number of bolls took place between August 1 and September 1. But such differences are reflected in observations on the stage of maturity of the plants. By September 1, and on later dates, the forecasting problem reduces primarily to predicting the number of bolls (large plus small) present on that date which will reach maturity. Approximately 5 percent of the total bolls counted do not reach maturity and another 5 percent are missed in picking. Bolls reaching the large boll category by October 1 represent the total which may be expected to mature by harvest, however, a 4-5 percent reduction for cotton missed in picking is still needed to arrive at an estimate of cotton which will be ginned.

August 1 Forecast: The techniques for translating fruit counts into yield forecasts, as described in the Report on the 1954 Research Surveys, have been modified for the August 1 Forecast. The approach which has been developed make use of data on stage of maturity, plant capacity and rate of fruiting. These refinements are obvious applications of what is known about the fruiting characteristics of the plant. This approach is sufficiently flexible to be adaptable to individual States as well as to the Belt as a whole. It utilizes all the information entering into previous procedures and, in addition, uses the fruit count data to establish the stage of maturity of the plants in forecasting the bolls to be formed after August 1.

If the total amount of fruit in all categories on the cotton plant on any date is plotted against time, the resulting figure is a typical S-shaped growth curve. Fruiting increases rapidly during the first 3 weeks after squares begin to appear. About 3 weeks after squaring starts, small bolls begin to appear and the plant is adding fruit at its maximum rate. From that time on, the rate at which fruit is added begins to deminish and continues to diminish for the next 3 weeks until large bolls begin to appear. When that stage is reached, the total amount of fruit on the plant shows little or no further increase. As large bolls begin to appear about 6 weeks after squaring began, the growth curve may be divided into clearly recognizable portions which can be related to the observable stage of maturity of the plants.

If the maximum fruit load is represented by A, that maximum is reached about 6 weeks after squaring began. Because the growth curve is approximately symetrical, the plant has about one-half of its maximum load about 3 weeks after squaring began; this is the stage at which blooms and small bolls begin to appear. All

plants in the first category of table 5.43 must be in a stage of maturity corresponding to a fruit load ranging anywhere from zero to A/2, depending upon whether squares are just beginning to appear or whether the plants already have squares that are almost ready to burst into bloom. The average plant in that category should have been squaring for about 1.5 weeks and should have about one-fourth of its ultimate maximum load. By the same token, plants showing squares, blooms and small bolls, but no large bolls, should range from those on which blooms are just beginning to appear to those on which some small bolls are almost ready to graduate to the large boll category. These plants will have been fruiting for 3 weeks to 6 weeks, with an average of 4.5 weeks. The fruit load on an average plant in that category should be halfway between A/2 and A or 3A/4. The average plant in the second category in table 5.43 thus has about three-fourths of its total final load.

Table 5.43 - Classification of fields by maturity of plants on August 1

Kind of fruit present	1954	1955
	Percent	Percent
Squares only	6.5	24.9
Squares, blooms, and small bolls	18.4	21.3
Large bolls, and other fruit	75.1	53.8
Total	100.0	100.0

These characteristics of the cotton plant make it possible on August 1 to predict the total amount of fruit that will be on the average plant by the time it has its total final load. In terms of A, the amount of fruit on the average plant as of August 1, 1954 is .065 (A/4) + .184 (3A/4) + .751 (A) = .905A. This means that the average plant on August 1, 1954 was carrying 90.5 percent of its total potential load. Similar computation may be made for the August 1, 1955 data. In terms of the maximum potential fruit load, the average plant had .249 (A/4) + .213 (3A/4) + .538A = .760A, or was carrying 76 percent of its total potential load.

Table 5.44 gives the actual fruit counts on August 1 for the two years.

Table 5.44 - August 1 fruit counts per 10 feet of row

Kind of fruit	1954	1955
Large bolls (including burrs and open bolls)	22.6	20.4
Small bolls	19.1	17.2
Blooms	9.6	6.3
Squares	78.5	84.9
Total fruit (T)	129.8	128.8
Indicated total boll load (C)	143.4	169.5
Additional squares or fruit to be set (C-T)	13.6	40.7

The total potential for the two years may be computed from the average number of fruit present on August 1 and the indicated fraction of the total potential which the average plant already has. It should be clear from what has been said that for 1954, 0.905A = 129.8 and for 1955, 0.760A = 128.8. That is, in 1954, A was equal to 143.4 and in 1955, A was equal to 169.5. This shows quite clearly that on August 1, 1955 the average cotton plant already showed a much higher fruiting potential than on August 1, 1954.

But the main forecasting problem on August 1 refers to estimating the rate at which bolls are being formed on that date. An approximation to that rate can be derived by noting that the total amount of fruit on the average plant increases from zero to A, in about 6 weeks. The increase during the first 3 weeks is about the same as during the last 3 weeks. The average weekly rate of fruiting during the entire 6-week period is thus approximately A/6. The rate at which fruit is being set as of August 1 can be derived from the indicated plant capacity (A) and the percent of fields in each of the three stages of maturity. Plants in the square and small boll stages are setting fruit at an average weekly rate of approximately A/6, if the increase is assumed to be practically linear over the 6-week period. Plants in the large-boll stage are no longer increasing their total number of fruit. Hence, the average rate of fruiting for all plants in terms of fruit set per week, is .065 (A/6) + .184 (A/6) + .751 (0) = .0415A or about 6 units per week as of August 1, 1954. In 1955 the fruit was being set at a rate of .249(A/6) + .213(A/6) + .538 (0) = .077A or 13.1 units per 10 feet of row as of August 1. Plotting the actual bolls formed between August 1 and September 1 in 1954 and 1955 against the rate of fruiting, a proportional relationship between the two variables is observed. The slope of the proportional line is 2.97. In other words, the number of blooms and bolls still to be formed after August 1 is about 2.97 times the weekly fruiting rate computed from the maturity classification data. The increase in bolls is shown in table 5.45.

Table 5.45 - Bloom and boll counts per 10 feet of row as of August 1 and September 1

Kind of fruit	1954		1955	
	August 1	September 1	August 1	September 1
	Number	Number	Number	Number
Blooms and small bolls	28.7	12.1	23.5	24.7
Large bolls	22.6	56.6	20.4	58.5
Total	51.3	68.7	43.9	83.2
Change from August 1 to September 1	+ 17.4		+ 39.3	

As pointed out above, the observed ratio (or slope) of additional bolls formed to the rate of fruiting is approximately 3. This empirical result may reflect a basic limitation of the plant to add bolls during this interval of time. For instance, the source of the additional bolls is largely the August 1 squares. Consequently, we should like to know if the computed weekly rate of setting all kinds of fruit is the same as the weekly rate of setting bolls on August 1, or how it may be related to the setting of all fruit. The squares which are set after August 1 provide a definite clue that such is the case. While the rate of fruiting indicates the increase in all kinds of fruit in one week which, if continued for 3 weeks, would result in a similar number of new squares being added to the plants. This is apparently about what happened in 1955 since 38.9 new squares were present by September 1. Actually, the rate of setting squares and bolls must have been about the same; that is, equal to the rate of fruiting. Since three weeks are requred for all the squares present on August 1 to reach the boll stage, the ratio of the bolls added to the weekly rate of fruiting is necessarily a function of the time required for the squares to reach the boll stage and the weekly rate of setting squares. The observed ratio (approximately 3) of bolls added to the weekly rate of fruiting on August 1 seems to reflect the time interval required for all of the squares present to reach the boll stage.

The various approaches studied in connection with the 1954 data were used and tested in light of the plant and fruit characteristics for 1955. The actual August 1 counts without making any allowance of the difference in stage of maturity between the two years result in forecasts which are too low due to the lateness of the crop in 1955 as compared to 1954. It would seem more logical to take into consideration the additional squares which may be expected to be set after August 1, in making the yield forecast. That is, the squares to be added after August 1, that is the 40.7, are treated the same as the 84.9 which were counted on August 1. The multiple regression equation computed from the 1954 data indicates that 26.3 large bolls will be added between August 1 and September 1 which is considerably less than the 38.1 observed.

The "probability of survival" model studied in 1954 was also tested. It was possible to study the validity of parameter based on the average age of fruit by means of tagged fruit counts. The number of bolls which would reach maturity, based on the "probability of survival" model, are given below. The fields were classified into 4 maturity categories as follows: (1) large bolls present, 212 fields; (2) no large bolls, but small bolls present, 67 fields; (3) no large or small bolls, but blooms present, 18 fields; and (4) only squares present, 98 fields. The number of fields in each category was used to weight the postulated parameters to obtain the average probability of survival to be used for each of the four classes of fruit. The postulated parameters and the weighted values used for 1955 given in table 5.46.

Table 5.46 - Probability of survival parameters for categories of fruit by field stage of maturity and weighted values based on 1955 data

Kind of fruit	Field stage of maturity				Weighted
	(1)	(2)	(3)	(4)	Value
Large bolls.....	1.000	-	-	-	1.000
Small bolls.....	.761	.779	-	-	.765
Blooms.....	.500	.512	.957	-	.530
Squares.....	.239	.244	.457	.50	.315
Number of fields..	212	67	18	98	395

Stages 1 and 2, and 3 and 4, could be combined for practical purposes. However, the four stages have been used in this analysis. The computed average or weighted values, as shown in the last column on the right, indicate the number of bolls that will reach maturity. The average numbers of fruit counted on August 1 are given in table 5.44. Squares to be added after August 1 were treated the same as the squares counted on August 1. The expected number of bolls reaching maturity is 1.000 (20.4) + .765 (17.2) + .530 (6.3) + .315 (125.6) = 76.5. The number of large bolls counted on October 1 was 75.3. If a 5 percent allowance is made for cotton missed in picking, the indicated bolls per 10 feet of row which would be ginned is 75.3 (.95) = 71.5. The number of bolls per 10 foot row, based on ginning data and the average weight per boll, for the 1955 crop was 72.4.

The third, or empirical, model studied in connection with the 1954 data indicates that the number of bolls expected at the end of the season would be (20.4) + (17.2) + (.2216)(125.6) = 65.4. This is slightly less than indicated by the multiple regression approach and considerably less than the number of bolls picked and on the plant at maturity.

Based on the results to date, the rate of fruiting approach and the "probability of survival" model appear to give satisfactory results when the stage of maturity of the plants is taken into consideration. While the multiple regression and empirical techniques offer feasible approaches, the parameters appear to be subject to considerable year to year fluctuations.

September 1 Forecast: By September 1, the forecasting problem for the belt is primarily one of determining the total number of bolls and blooms per unit and the weight of seed cotton per boll. The blooms and bolls already on the plants by September 1 seem to determine the yield. Results for 1954 and 1955 indicate that the yield, based on this count and the weight per boll, represent about 91 percent of the cotton that will be ginned. For Oklahoma and the High Plains of Texas, a small amount of cotton is produced by squares present on September 1 when the crop is late. For States in which there is relatively little cotton open by September 1, a method of estimating the weight per boll may be needed. However, for the belt as a whole, the average weight per boll through September 1 differs only slightly from the final cumulative average for all cotton picked during the entire season. The data for September 1, 1955 give the following yield per acre:

$$\text{Gross pounds of seed cotton per acre} = \frac{(\text{Bolls per field})\ (\text{Seed cotton per boll in grams})\ (\text{Sq. ft. in acres})}{(\text{Grams in pound})\ (\text{Sq. feet in field plots})}$$

$$= \frac{(332.6)\ (5.024)\ (43560)}{(453.592)\ (138.792)} = 1156$$

$$\text{Pounds of seed cotton ginned per acre} = 1156\ (.91) = 1052$$

$$\text{Pounds of lint ginned per acre} = 1052\ (.37) = 389$$

The Board's September 1 forecast was 336 pounds of lint per acre for the 10 States.

October 1 Forecast: The large bolls set by October 1 account for the number reaching maturity by harvest. However, the October 1 counts are complicated by farm harvesting practices. Cotton is being harvested in most areas of the 10-State region during the month of September. The procedure followed in making fruit counts was to arrive at counts each month that would include bolls that had been picked. In other words, the counts were to correspond to the total final production and not merely to the portion remaining for harvest as

of any date. It appears that, where a field has been picked only once prior to October 1, an accurate count can be obtained by including the burrs in the total. However, if the field has been picked more than once, or snapped by either the farmer (or enumerator), the total count was too low. Where the cotton has been hand snapped, the October 1 count is apt to be much too low. In fields which have been picked by hand or machine, the count is somewhat too low after the second picking because pickers knock off dried burrs from the previous picking. Also, it may be more difficult for the enumerators to see burrs after cotton has been picked because of the lack of any distinctive color or shape to make them stand out against leaves and branches. In such cases, the September 1 count of bolls and blooms has been used as the total count of large bolls set for the season. As some mortality of bolls will occur in a month's time, the October 1 count can be expected to be somewhat lower than the September 1 count.

An alternative solution would be to count only bolls still on the plants at the time of each visit and relate that count to cotton still to be picked. Current ginning data up to the date of the survey could be added to the forecast of cotton still to be harvested, as computed from fruit still on the plants, to provide a forecast of the total crop. Such a procedure might not be satisfactory if there is any appreciable lag between the time the cotton is picked and when it is taken to the gin. A third alternative would be to tag all large bolls on a subsample of units, or on half of a unit (10 feet of row), and determine the disappearance of tagged large bolls between September 1 and October 1, or the additional large bolls formed during the month (untagged bolls on October 1) to add to September 1 large bolls to arrive at a total for the season.

For October 1, the forecasting procedure reduces to a total count of large bolls and the weight of seed cotton per boll. However, a 4 percent reduction for cotton missed in picking is still assumed, but no allowance is made for small bolls and blooms not reaching maturity as is necessary on September 1. The October 1 data and accumulated boll weights for 1955 give the following yield per acre:

$$\text{Gross pounds of seed cotton per acre} = \frac{(301)\ (5.027)\ (43560)}{(453.592)\ (138.792)} = 1047$$

$$\text{Pounds of lint cotton ginned per acre} = 1005\ (.37) = 372$$

This yield applies to an acreage in cultivation as of August 1. Acreage abandonment between August 1 and harvest has been of the order of 1 or 2 percent in 1954 and 1955. The October 1 forecast by the Crop Reporting Board was 369 pounds of lint for the 10-State area.

Corn: Analysis of the 1954 surveys resulted in two distinct yield-forecasting devices for the September 1 and October 1 forecast dates: (1) a relationship on September 1 between the total accumulated ear sizes for a row (or unit) and the weight of grain at "maturity", and (2) an actual harvesting of corn from the plots with the weights being determined and adjusted to a standard moisture content. Results from the 1955 surveys seemed to bear out the validity of these two procedures even though the crop was grown under vastly different conditions. In 1954, the season was very dry and the crop was early while in 1955, there was ample rainfall and the crop was slower in maturing. In 1955, a survey was also conducted on August 1 to develope forecasting procedure for that date. By the time a field reaches the "milk" stage the ear length is established. Practically all fields in the Southern States will have reached this stage by September 1, even in years when the crop is late. By October 1 the total dry matter is laid down even though the corn is not ripe enough to harvest. Therefore, corn on the sample plots can be weighed to determine the yield. The weight must be adjusted to a standard moisture content and an allowance must be made for harvesting loss. In 1955, corn found in the field after the farmer harvested the crop averaged 4 percent of the indicated gross yield. This compares eith the 9 to 10 percent found in 1954.

August 1 Forecast: On August 1, it is necessary to forecast the total number of ears. In many States all the ears have not yet formed by that date. In addition, the weight per ear must be estimated from : (1) an assumed average weight, (2) a forecast of the weight, based on the size of the early-formed ears, or the rate at which the crop is developing. Preliminary studies suggest that a rapid rate of crop development may also mean a higher weight per ear.

Two procedures for estimating the total ear count have been considered. Both indicate promise, but probably can be refined: (1) assuming a constant ratio of ears with grain to number of stalks per row, and (2) using the stage of development to estimate the fraction of total capacity represented by the observed ear count. The latter procedure is similar to that used to forecast the total set of fruit for cotton. The 1955 data for Tennessee were analyzed on this basis, as the crop was later in this State than in any of the other States in the survey. Fields were classified into four maturity categories: (1) less than 25 percent of the stalks having ears or silked ear shoots (45.8 percent in this group), (2) 25 to 49 percent of the stalks having ears or silked ear shoots (10.4 percent in this group), (3) 50 to 80 percent of the stalks having ears or silked ear shoots (18.8 percent in this group), and (4) over 80 percent of the stalks having ears or silked ear shoots (25.0 percent in this group). It was assumed that the total ear capacity was linearly related to the fraction of stalks having ears or silked ear shoots. That is, on the average, the ears or silked ear shoots counted on August 1 in the 4 categories of fields represented 12.5 percent, 37.5 percent, 65 percent and 90 percent of the total "ears" which will form. However, experience in the Southern States indicate that only about 90 percent of the total stalks have ears. Consequently, the average percent of capacity represented by the counts was taken to be 12.5/90, 37.5/90, 65/90, and 90/90 respectively for the four categories. Or, the average

unit (or field) had only (.458)(.139A) + (.104)(.417A) + (.188)(.722A) + (.25)(1.00A) = .493A, where A is the total ears to be formed per 60 feet of row. The August 1 count of "ears" was 18.4 per 60 feet of row, hence, the forecast of the total number of ears which will form is 18.4/.493 = 37.3 per 60 feet of row. The September 1 ear count was actually 35.5 per 60 feet of row.

Using the first procedure, which assumes a constant ratio of "ears" to stalks, the analysis indicates that about 1.20 ears will form for every stalk counted on August 1. However, experience in the Southern States indicates that only about 90 percent of those "ears" will produce grain. This procedure would indicate (28.5) (1.20) = 34.2 "ears" per 60 feet of row. Preliminary study of weight per ear and total ear potential suggests that for each 10 additional ears expected per 60 feet of row, the weight per ear increases about one-tenth of a pound.

September 1 Forecast: For September 1, the relationship between accumulated ear sizes and weight of ear corn for the sample plots seems adequate for forecasting a gross yield per acre. The indicated relationship between accumulated ear length and weight of ear corn on 15 feet of row is approximately:

$$\text{Pounds of ear corn per 15 ft. row (15.5\% moisture)} = .045\ X$$

Where X = accumulated number of inches of ear length in 15 feet of row (measured over husks)

The sample plots in each field contain four such 15-foot row sections. For fields in which the corn is ripe, ears would be husked and weighed, and sample ears selected for determination of moisture content and shelling percentage. The average weight of ear corn for all sample plots would be used to compute a gross yield per acre. The yield per acre may be computed from ear length in immature fields and from the weight of ear corn in fields where corn was mature enough to weigh.

The 274 immature fields indicate a weight of 10.73 pounds of ear corn per 60 feet of row and 100 mature fields show 10.77 pounds. The yield per acre at standard moisture content would be:

$$\text{Gross pounds of shelled corn per acre (15.5\% moisture)} = \frac{(\text{lbs. of ear corn})\ (\text{shelling percent})(\text{sq. ft. in acres})}{(\text{lbs. in bushels})\ (\text{length of row})\ (\text{row width})}$$

$$= \frac{(10.74)\ (80.22)\ (43560)}{(56)\ (60)\ (3.475)} = 32.14$$

$$\text{Net pounds of shelled corn per acre (15.5\% moisture)} = 32.1\ (.90) = 28.9$$

The Crop Reporting Board's September 1 forecast was 27.3 bushels per acre for the 10 States. If even ripe corn is not to be picked and weighed, a similar relationship between accumulated ear length and the weight can be used ro estimate the weight of ear corn per 15 feet or row. The indicated relationship for ripe ears is:

$$\text{Pounds of ear corn per 15 ft. row (15.5\% moisture)} = .053\ X$$

To obtain the net yield per acre, a harvesting loss of about 10% must be subtracted from the gross yield. In 1954, post-harvest gleanings were about 9 percent of the gross yield indicated on October 1. In 1955, the gleanings were only 4 percent. Post- harvest experience gained in connection with the Iowa State Corn Project indicates that gleanings are usually about 10 to 15 percent of the gross yield indicated by harvesting sample plots.

October 1 Forecast. As the total dry matter is laid down by this date, the sample plots can be harvested and the yield estimated from the weight of corn found.

The indicated yield would be computed at standard moisture content and adjusted for harvesting losses. The indicated 1955 yield per acre was:

$$\text{Gross pounds of shelled corn per acre (19.2\% moisture)} = \frac{(\text{lbs. of ear corn})\ (\text{shelling pct.})\ (\text{sq.ft. in acres})}{(\text{lbs. in bushels})\ (\text{length of row})\ (\text{row width})} =$$

$$\frac{(12.1)\ (.796)\ (43560)}{(56)\ (60)\ (3.475)} = \frac{419,552}{11,676} = 35.9$$

$$\text{Gross pounds of shelled corn per acre (15.5\% moisture)} = (35.9)\ (.956) = 34.3$$

$$\text{Net pounds of shelled corn per acre (15.5\% moisture)} = 34.3\ (.90) = 30.9$$

The Crop Reporting Board's October 1 estimate was 27.4 bushels per acre for the 10 States. The Board's December 1 estimate was 28.2 bushels. In addition to the procedures which have been discussed, a number of other specific relationships have been studied based on totals per 15 feet of row and the weight of corn harvested from the sample plots.

The 1954 data indicated that surface area or length of an ear was more highly correlated with weight of ear corn than was the volume of the ear. Consequently, the 1955 studies were restricted to surface area and ear length relationships. A model based on the amount of surface area covered by kernals, i.e. "producing surface", was set up for two maturity classes as follows:

$$W_i = b_o + b_1 (L_i \times C_i \times F_i) + E_i$$

where

W_i = wt. of ear corn (tenths of lbs. at 0% moisture) in 15 ft. row

L_i = length of ears in 15 ft. row (inches)

C_i = circumference of ears in 15 ft. row (inches)

F_i = percent fill of sample ears (decimal fraction)

E_i = random error component with mean zero

For fields in the Dent or Ripe stage, data for the sample plots indicate:

August 1 $W = 15.5 + .00240 (L \times C \times F)$

$R^2 = .63$, $S_e = 7.99$, $S_b = .00018$, and $N = 102$

Sept. 1 $W = 14.4 + .00298 (L \times C \times F)$

$R^2 = .67$, $S_e = .094$, $S_b = .00015$, and $N = 189$

For fields in the Milk and Dough stage the corresponding equations are:

August 1 $W = 16.4 + .0024 (L \times C \times F)$

$R^2 = .53$, $S_e = 10.7$, $S_{b1} = .00023$, and $N = 90$

Sept. 1 $W = 12.7 + .0034 (L \times C \times F)$

$R^2 = .71$, $S_e = 6.90$, $S_{b1} = .00038$, and $N = 35$

A simple relationship between length of ears in 15 feet of row and weight of ear corn gives the following results:

For fields in the Dent or Ripe Stage:

August 1 $W = .332 + .381\ L$

$R^2 = .80$, $S_e = 5.84$, $S_{bl} = .0189$, and $N = 102$

Sept. 1 $W = 1.75 + .445\ L$

$R^2 = .78$, $S_e = 7.70$, $S_{bl} = .0184$, and $N = 189$

For fields in the Milk or Dough Stage

August 1 $W = .612 + .364\ L$

$R^2 = .74$, $S_e = 8.05$, $S_{bl} = .0230$, and $N = 90$

Sept. 1 $W = .76$, $S_e = 6.26$, $S_{bl} = .0367$, and N 35

Winter Wheat: The meager sample of fields in the spring of 1955 makes any analysis highly sepculative. However, the work indicates that in the Great Plains it is desirable to express yield forecasts in terms of the total acreage standing at the time of the first survey. In years of heavy abandonment, the acreage that will actually be harvested is too much of an unknown before harvest. Even after harvest, the acreage actually combined may still be in doubt because only parts of fields may be combined. Under these conditions, the grower can estimate the acres combined in any field only approximately.

While the same type of production check data as for cotton are not available, growers seem able to report accurate production data. But where portions of fields had been abandoned, growers were unable to estimate accurately the acreage actually harvested.

The type of approach which is being considered for a May 1 forecast would involve an estimate of the heads expected, based on a stalk or tiller count. This indicates the total number of heads which can form. The fraction which might be expected to produce heads is probably related to the May 1 stage of maturity. As few fields have headed by May 1, the average weight of grain per head must be assumed or estimated from other plant characteristics.

By June 1 the number of "heads" present probably represents the total that can be expected to form by harvest. Length of head appears to be established early and the total length of all heads in a unit appears to be a satisfactory indicator of the weight of grain to be expected. However, for fields in the ripe or hard dough stages, the grain can be harvested and threshed to obtain the weight of grain. The July survey is largely a post-harvest visit since a majority of the fields are harvested prior to this time. For late maturing fields, heads can be harvested and threshed to obtain weight of grain. The July 1 weight of grain per unit for these fields could be combined with June 1 indication from harvested fields to obtain an indication for all sample fields.

5.6 Yield Characteristics of Fields and Plots within Fields by Location

A study was made of yield differences between fields located on and off roads on county highway maps. While it has frequently been more convenient and cheaper to use a route sample in objective yield work, the question of biases which may be associated with such samples has made the interpretation difficult. As county highway maps provide a suitable frame for sampling all fields on public roads, each field in the present survey was classified as being on or off a road on the county highway map. In most States, public roads cover the range of agricultural variation present; consequently a probability sample of fields on such roads might give unbiased yield characteristics for all fields in a given area. Tables 5.47 and 5.48 show the average cotton and corn counts for fields in the 10-State area classified according to this criterion.

Table 5.47 - Classification of cotton fields by location with respect to roads on county highway maps

Month and Item	On Roads (1)	Off Roads (2)	(2) ÷ (1)
August 1:			
No. of burrs, open bolls, and large unopened bolls per 40 ft. row	92.6	68.2	73.6%
Distance between rows (ft.)	3.56	3.36	94.4%
Number of fields	213	181	--
September 1:			
Number of burrs, open bolls and large unopened bolls per 40 ft. row	236.6	230.9	97.5%
Number of fields	211	179	--
October 1 (Final Pre-harvest Survey):			
No. of burrs, open bolls, and large unopened bolls per 40 ft. row	299.1	289.5	96.8%
Number of fields	215	182	--

Table 5.48 - Classification of corn fields by location with respect to roads on county highway maps

Month and Item	On Roads (1)	Off Roads (2)	(2) ÷ (1)
August 1:			
Number of ears per 60 ft. row....	30.7	30.8	100.3%
Distance between rows (ft.).....	3.45	3.49	101.2%
Number of fields.....	151	221	--
October 1 or final pre-harvest survey:			
Number of ears per 60 ft. row.....	30.6	30.5	99.9%
Weight of ear corn for 60 ft. row.	12.0	12.3	102.5%
Number of fields.....	155	227	--

Table 5.47 suggests there may be important differences for cotton fields on and off such roads. Fields on roads had reached a more advanced stage of maturity by August 1 than fields off roads. In addition, the distance between rows is greater for fields on roads. The September 1 and October 1 differences in boll count are not statistically significant. However, the large differences found on August 1 suggest that there may still be a small upward bias associated with fields on roads because of their more advanced stage of development by August 1 resulting in an earlier maturity.

Data for corn fields show only very small differences and in the opposite direction from those found for cotton.

Within sample fields the pairs of sample plots were selected by two procedures. But the enumerators were not informed of that fact. For the first field an enumerator encountered in any size and shape group, the sample plots were located according to predetermined random steps and row numbers starting from the first corner of the field encountered in approaching the field. For the second field, and every other field thereafter in each group, sample plots were located systematically within the nearest 80 rows and 80 steps from the first corner of the field. The differences shown in Tables 5.49 and 5.50, are not significant though all counts are higher for the random plots.

Table 5.49 - Random vs. systematic method of locating pairs of sample plots in cotton fields - final pre-harvest survey

Count	Method of plot location		
	Random (1)	System. (2)	(2) ÷ (1)
Number of burrs, open bolls, and large unopened bolls per 40-foot row	297.6	290.3	97.5%
Number of fields	215	182	--

Table 5.50 - Random vs. systematic method of locating pairs of sample plots in corn fields - final pre-harvest survey

Count	Method of plot location		
	Random (1)	System. (2)	(2) ÷ (1)
Number of ears per 60 ft. row	30.7	30.4	99.0%
Weight of ear corn 60 ft. row (lbs.)	12.3	12.0	96.9%
Number of fields	224	158	--

If the differences in tables 5.49 and 5.50 really represent true yield differences, it seems likely that a systematic scheme which would put the plots farther into the field would eliminate them.

5.7 Tables of Selected Yield Characteristics by States

Cotton Surveys: Pertinent data for August 1, September 1, and October 1 used in the yield studies are summarized in tables 5.50, 5.51, and 5.52.

Table 5.50 - Cotton count data August 1, 1954 & 1955

State	August 1, 1954		August 1, 1955						Row spacing (ft.)
					For 4 hills or plants 1/				
	No. fields	Large bolls per 40 ft.	No. fields	Large bolls per 40 ft.	Large bolls	Small bolls	Blooms	Squares	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ala.	12	82.6	28	86.5	14.3	13.2	6.1	73.3	3.44
Ark.	27	68.6	44	48.2	4.4	12.8	6.4	90.2	3.23
Ga.	8	159.4	16	164.6	27.8	20.5	4.1	53.0	3.23
La.	7	138.4	18	115.3	13.8	14.7	7.2	75.5	3.37
Miss.	21	162.0	42	82.0	5.5	17.5	6.2	92.6	3.13
N. C.	3	31.6	8	4.75	.50	8.75	6.38	102.5	3.61
Okla.	12	10.3	28	16.7	2.71	3.68	1.18	15.6	3.28
S. C.	11	224.2	20	192.4	26.4	15.3	4.8	45.8	3.17
Tenn.	8	33.2	18	2.61	.56	3.11	1.72	31.6	3.04
Texas	77	69.6	174	87.0	11.8	4.8	1.5	20.7	3.75
10 States	186	90.4	394	81.4	11.11	9.38	3.45	46.4	3.47

1/ Column 4 divided by column 5 is the expansion factor for hill counts to a 40 ft. row basis.

Table 5.51 - Cotton count data September 1, 1954 and 1955

State	Sept.1 counts-'54	September 1 counts - '55						
			For 4 hills or plants 1/					
	Large bolls per 40 ft.	Total bolls or forecast 40 ft.	Large bolls per 40 ft.	Large bolls	Small bolls	Blooms	Total bolls per 40 ft. row	Wet weight seed cotton per boll	Weight seed cotton per boll
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ala.	212.2	240	341.5	54.3	17.1	5.6	484.3	6.82	6.06
Ark.	342.4	414	363.1	50.8	21.5	4.9	544.7	6.67	6.05
Ga.	193.2	203	281.1	42.8	7.1	1.5	337.6	6.58	6.21
La.	387.6	435	284.2	40.6	12.8	2.7	392.7	7.61	6.01
Miss.	354.6	407	342.0	54.3	21.3	4.3	503.2	6.13	5.82
N. C.	302.0	318	276.9	37.1	9.1	1.3	354.9	--	--
Okla.	115.6	235	132.5	13.3	6.9	3.2	232.5	5.86	4.55
S. C.	271.4	308	339.5	51.0	6.7	0.3	386.1	7.95	6.24
Tenn.	257.8	328	232.9	33.5	17.4	6.8	401.1	--	--
Texas	130.6	170	154.9	18.0	5.5	1.5	225.1	4.73	4.54
10 States	226.6	275	233.8	32.2	10.8	2.79	331.8	5.61	5.02

1/ Column 3 divided by column 4 is the expansion factor for hill counts to a 40 ft. row basis.

Table 5.52 - Large boll counts October 1, 1955 or final pre-harvest survey

State	No. large bolls per 40 ft.	Wet weight seed cotton per boll	Dry weight seed cotton per boll
	Number	Grams	Grams
Ala.	401	6.27	5.70
Ark.	450	5.64	4.92
Ga.	296	5.92	5.47
La.	367	5.60	5.22
Miss.	426	5.98	5.29
N. C.	307	5.07	4.75
Okla.	262	7.11	5.92
S. C.	359	6.14	5.28
Tenn.	376	5.69	5.13
Texas	208	4.77	4.42
10 States	301	5.594	5.03

Corn Survey: Pertinent data for the September 1 Survey and a summary of the final pre-harvest field counts are given in table 5.53.

Table 5.53 - Summary of corn counts September 1, 1955 and final pre-harvest survey

State	September 1 Survey								Final pre-harvest survey	
	No. fields selected	Ear characteristics			Counts per 60 ft. row				No. ear with grain	Field weight of ear corn
		Length of ear	Circum. or ear	Percent fill	Number stalks		Silked "ears"	Row spacing		
					Total	With ears				
	Number	Inches	Inches	Percent	Number	Number	Number	Feet	Number	Pounds
Ala.	52	7.9	6.7	86	25.8	23.2	30.5	3.54	29.2	12.7
Ark.	16	9.0	7.1	77	29.6	27.4	33.9	3.25	25.8	11.4
Ga.	72	6.5	6.4	85	23.7	21.6	28.0	3.47	26.0	9.0
La.	12	5.6	5.2	89	34.8	30.6	41.9	4.21	41.1	13.4
Miss.	56	6.8	6.0	83	31.2	28.5	35.6	3.32	31.6	12.2
N. C.	48	6.4	6.5	80	32.9	30.3	43.3	3.66	36.8	16.1
Okla.	4	7.4	7.0	86	34.5	33.5	34.5	3.10	25.0	6.7
S. C.	38	6.4	6.7	74	28.8	25.2	34.1	3.73	33.1	10.7
Tenn.	48	6.0	5.0	80	27.8	24.3	35.2	3.33	30.4	13.7
Texas	54	6.9	6.4	79	23.0	22.4	30.2	3.27	26.8	11.1
10 States	400	6.7	6.2	82	27.6	25.1	33.6	3.47	30.4	12.0

6. Summary of Projects at Statistical Laboratories

Studies on corn were continued, with modifications, at the Iowa Statistical Laboratory. Work on cotton was also continued at North Carolina State College Statistical Laboratory. In addition, the laboratory made a study of the "closed segment" versus the "open segment" for farm surveys. Only a summary of the results from these two projects is contained in this report; a more detailed account may be found in the annual reports from the two institutions.

6.1 Corn Project at Iowa State College

Objectives:

(1) To collect information on the growth characteristics of corn, as a basis for making early season yield forecasts.

(2) To compare yields reported by growers with those obtained by objective methods.

(3) To compare the volume of corn measured in farmers cribs and bins with farmers' judgment estimates of bushels.

(4) To ascertain the relationship between size and weight of grain at the standard 15.5% moisture content.

Method of Study: The sample of 200 farms used in 1953 and 1954 was used again in 1955. On August 1, and every two weeks thereafter until harvest, 50 farms spread across Crop Reporting Districts 2, 5, and 8 were visited. Twenty-five of these farms were visited on every occasion while 25 new farms were introduced on each trip. Farmers were interviewed for farm size, yield forecasts, acres planted, acres intended for harvest, statement of last year's production, and cultural practices.

On each of the new farms introduced on each trip, three corn plots, each 2 rows wide and 25 feet long, were randomly selected. The number of stalks and ears on each row were counted and recorded. The length and circumference of one-third of the ears in the plot were measured on the stalk and then picked, husked, and weighed. Finally, two ears from each plot were placed in a moisture proof plastic bag and sent back to Ames for moisture and shelling percentage determinations. The procedure on the 25 farms which were revisited on each trip was slightly different. On these farms, a plot was 3 rows wide and 25 feet long. The number of ears on each plot was counted and recorded. On each trip the investigator went back to the same 3 plots and selected two ears from each plot to be sent back to Ames.

After harvest, farms were visited to determine the amount of corn left in the fields. While the investigator was on these farms, he made volume measurements of the 1955 corn contained within the cribs and obtained the farmers' stated production, utilization, and amount of corn harvested over and above that contained

within the cribs. finally, visits were made to several A.S.C. offices for data on the relationship between the volume of corn in the cribs and the corresponding weight of shelled corn. Form their files, data on initial selling volume and warehouse receipts of the weight of shelled corn (with moisture determinations) could be obtained and compared for different years as well as for different locations. It was thought desirable to use this information in an initial attempt to determine the relationship between the volume of ear corn and the number of pounds of shelled corn contained within this volume.

Results of Studies: The summary of reported acres intended for harvest as grain and the farmer's estimate of final production showed no significant changes from one visit to another, over the period August 10 to mid-October. Data obtained from the objective yield work showed only minor variations in the estimated number of ears per acre (approximately 11,000) between the different trips. Hence, the number of ears per acre could be estimated early in the season and was numerically equal to about 90 percent of the number of stalks per acre.

The average weight of kernel matter per acre changed with stage of maturity over the season as was to be expected. The most interesting feature observed in the data is that most of the kernel weight was laid down in the 20 day period from August 10 to August 30. The average kernel weight per ear at the time of harvesting was .417 pounds at 15.5 percent moisture. Estimates of the amount of corn left in the fields after picking indicated that 2.7 bushels per acre were in the form of loose kernels, and 13.0 bushels per acre were on ears either still attached to the stalk or lying on the ground. Total gleanings amounted to 15.7 bushels per acre or about 19.6 percent of the gross yield actually produced by the plants.

Ear growth observations indicated that the maximum wet weight per ear was probably reached by September 1, but only about 92 percent of the final kernel weight was already laid down by this date. Information of this nature, collected over several years, could be used to make good early-season predictions of final kernel weight. The surface area of the ear also reaches its maximum about September 1. The density of kernel matter per square inch of ear surface was approximately the same at harvest time for both years studied. The kernel surface area on August 10 is within a few square inches of the surface area at harvest time. This suggests that kernel surface (or ear size) can be used to forecast final ear weight at harvest.

Wet ear weight, kernel surface area, shelling percentage, and dry kernel weight per square inch of surface area, all showed a regularity over the growing season. There seems to be a definite possibility that this course of development may be used "to match up" different crop years in respect to crop maturity. In particular, if corn matures in about the same fashion every year, a forecast of average weight of mature grain per ear could be made early in the season. An objective forecast of yield could be made by observing the maturity of the crop at any particular date and the length of time remaining for the ear to grow.

The relationship between crib volume and farmers' stated number of bushels of corn in the crib for 1955 would lead to an indication of 0.3789 bushels per cubic foot. In 1954, it was 0.3488 bushel per cubic foot. It is ordinarily assumed that 0.4 bushels per cubic foot is correct. Visits made to two A.S.C. offices showed a variation in the true relationship between districts within a given year, and also a year to year variation within counties. The use of the same conversion factor for all counties and all years does not appear to be justified. An estimate based on farmers' reports of bushels in the crib seem to be to low.

6.2 Cotton Project at North Carolina State College

Objectives:

(1) To compare the closed segment approach with the farm-unit headquarters approach in agricultural surveys.

(2) To continue studies of sampling and nonsampling errors in determining acreage of cotton fields.

(3) To investigate random and nonrandom methods of locating sample plots within fields.

(4) To investigate early season production forecasts from subjective and objective data.

(5) To investigate the efficiency of repeated observations on the same sampling units in successive years for yield forecasts.

Method of Study: The universe for the study was defined as the open country in the Eighth Crop Reporting District of North Carolina from which 125 sampling units were selected. In addition to the segments selected from the entire population, ten sampling units which had been used in 1954 were again selected in two counties, Cleveland and Union, for studying repeated observations on the same sampling units in different years. The 9 x 9 aerial photographs were delineated to include the areas under consideration and given to the interviewers when they went out to contact the farmers.

A subsample of 40 sampling units, which were expected to contain about 100 cotton fields, was selected for objective counts. Acreages of cotton fields in this subsample were chain measured. Aerial photographs with a scale 330 feet to the inch were also obtained for the 100 cotton fields and the fields delineated on those photographs for measurements by planimeter and rotometer.

The objective counts were made as of August 1, September 1, and the plots harvested whenever enough bolls were open on the 6 10-foot double-row plots in each of the 100 fields. Three plots were selected at random in each field before the first visit from previous delineations on the photographs. Three other plots were selected by a systematic nonrandom procedure similar to that used in the more extensive surveys in the Southern States. Small bolls were tagged on one hill beyond the sample plot.

On September 1, mail schedules covering forecasts of cotton, corn, and wheat production were sent to the 440 farm operators found in the sample and growing these crops. A total of 176 returns was obtained from the two requests. A subsample of approximately 400 farms was selected for a final interview early in December.

Results of Study: Administratively, the closed segment approach was very successful. The 9 x 9 aerial photographs were very helpful. They were indispensible in areas where poor boundaries were shown on county highway maps. It was also much easier to describe an area when a picture was available. The time saved in locating and screening sample areas more than pays the cost of the photographs.

From an administrative point of view the closed segment is also suitable for collecting livestock data. Analysis of the data indicate that the closed segment is statistically more efficient than the farm headquarters approach. The increase in efficiency was, in general, from 12 to 56 percent. For a general-purpose agricultural survey with the closed-segment approach, two key items seem to hold a favorable advantage over others for sample allocation studies. These are past records of crop average harvested and number of farms. Cropland harvested should be preferred because it has a smaller range of fluctuation and the allocation to individual segments can be more easily carried out with aerial photographs (if the segment size can be equalized better). The other criteria considered as a basis for allocation were number of cotton fields, total farm acreage, value of livestock sold, and number of hogs.

Five measurements or estimates of acres were made for each cotton field. These were: Chain, farmer's estimate, A.S.C., planimeter and rotometer measurements on aerial photographs. The chain measurements were considered to be unbiased. If the other methods are expressed as a percent of the chain measurement, the following relationships are obtained: Farmer's estimate, 100; planimeter, 103.1; rotometer, 104.8; and A.S.C. (as obtained from county offices), 97.8. For the segments in Cleveland and Union counties which were arbitrarily included in the 1955 sample, no comparisons were made with the previous year; there had been little agreement in 1954 between A.S.C. measurements and farmers' estimates. However, the farmers' estimates were in total quite close to the chain measurement total.

In 1955 there was much closer agreement among the three methods, chain, farmers' estimate, and A.S.C. A cotton growers' association put on a drive for farmers to plant all their allotments. Many farmers called for pre-planting

measurements and many even over-planted (later plowed up). In 1955 the striking similarity in A.S.C. measurements and farmers' estimates reflected acceptance by farmers of A.S.C. "measured" figures.

The study in 1955 substantiated a finding of the previous year, regarding random and nonrandomplot selection in the sample fields. The counts and yields on the nonramdom (systematic) plots were lower as a whole; nonrandom plots located in the interior parts of the field would have overestimated the yield; on the border and end rows they underestimated the yield. Percentagewise, the nonrandom bias for September 1 large-boll counts was -6.0% compared with a -6.9% found in 1954 for two plots per field.

The studies relating to early-season production forecasts by combining subjective and objective type data indicate a correlation of the order of .91 between the expected production reported per field and final production per field. These are improved, by including objective counts, to R values of .92 to .94. When acreage is held constant, the correlation between the forecasted yield per acre and the final yield per acre is reduced substantially.

The tagging data reveal that an estimated 63 percent of the cotton crop was made from large bolls which were squares on August 1, and 33 percent from large bolls on September 1 which were classified as small on August 1. Only about 3 percent of the crop came from bolls that were large August 1 and the remaining 1 percent from fruit that was not present on August 1, but appeared as small bolls on September 1.

The data available for investigating the efficiency of forecasts from repeated observations on the same sampling units on successive years is meager. However, the correlations between the same characteristics in two different years for the items studied were .98 for cotton acreage, .89 for number of tracts, .84 for number of tracts with cotton, and .92 for number of cotton fields. The correlation indicate that this method of sampling in the same segments on successive occasions is practical. It was concluded that further investigation should be made of additional characteristics on larger samples.

7. Operations and Costs

The research program costs can most readily be discussed in 3 sections, the June Interview Survey, the objective measurement work, and the October 1 and December 1 surveys on a subsample of the farms enumerated in June.

7.1 June Acreage Survey

The June Survey using the "open-segment" approach was conducted the same in 100 counties as in 1954. The same segments were also used except that the 25 heavily populated segments were increased to 79 in 1955 and their size reduced proportionately to facilitate enumeration of those areas. Also, a supplemental list of 1,000 large farms in the 100 counties was to be enumerated. In addition, the "closed-segment" approach was tried in 101 area segments dispersed over 85 new counties in the nonwheat stratum of the 10-State region.

The 1955 research program was administered through the State Statisticians' Offices, similar to the way the 1954 program was administered. A new development was the hiring of Assistant State Supervisors in most States. Each State put one of its statisticians in charge of the work. That statistician and an Assistant State Supervisor attended the regional training school at Memphis. State training schools for enumerators were held and field work was supervised by the Statistician and his assistant. One enumerator was hired for the "open segment" and large farm interviews in each county, except in a few instances where the workload was too heavy.

Principal State costs of "open-segment" enumeration and comparison with last year are shown in tables 7.1, 7.2, and 7.3. Total absorbed costs remained about the same as the previous year. Supervision by statisticians seemed to take about the same amount of time even though the number of schedules increased by 23 percent.

Table 7.1 - Comparison of size and cost of 1954 and 1955 open segment survey

Item	Year	
	June 1954	June 1955
Number of interviews.....	2,795	3,403 1/
State office costs:		
"Out-of pocket".....	$24,496	$32,970
Absorbed.....	11,638	11,963
Total	$36,134	$44,933

1/ Includes 863 large farms

Table 7.2 - Principal costs of open segments in State offices in 1955

Item	Direct dollars	Absorbed dollars	Total dollars
Supervisor training	1,507	2,239	3,746
Ass't. supervisor training	1,891	-	1,891
Interviewer recruitment			4,333
Professional	817	2,867	
Reg. clerks	-	634	
L. A. clerks	15		
Interviewer training			10,207
Professional	208	1,529	
Ass't. supervisors	553	-	
Reg. clerks	-	22	
Interviewers	7,895	-	
Survey proper			22,177
Professional	1,157	2,185	
Ass't. supervisors	1,221	-	
Reg. clerks	-	621	
L. A. clerks	204	-	
Interviewers	16,789	-	
Editing questionnaires			2,579
Professional	318	1,858	
Ass't supervisors	298		
Reg. clerks	-	8	
L. A. clerks	97		
Total	32,970	11,963	44,933

Table 7.3 - State office costs per schedule in open segments

Item	June 1954	June 1955
"Out-of-pocket"	8.88	9.69
Absorbed	4.22	3.52
Total	13.10	13.22

Enumeration of the closed segments was done by the statistician and Assistant State Supervisor. Higher pay of these individuals no doubt made the cost per closed segment more than if enumerators had done the work. Table 7.4 shows the cost of the closed segment work.

Table 7.4 - Cost of closed segment enumeration

Item	Cost
Direct	$4,545
Absorbed	1,043
Total	$5,588
Cost per segment	$ 55.33

In 1955, the verification studies were conducted on about 200 fields alloted equally to cotton, corn, sorghum, and soybeans. These fields were selected from the aerial photographs used in the closed-segment portion of the June Survey. This insured that each field selected for study appeared on a large-scale photograph. An enlarged sketch for each sample field was also drawn to scale on graph paper to permit space for the recording of additional data or notes as might be required. This work was performed largely during September. The cost of this work is given in table 7.5.

Table 7.5 - Cost of acreage verification

Item	Cost
Direct	$1,313.74
Absorbed	725.77
Total	$2,039.51
Cost per field	10.20

7.2 October 1 and December 1 Surveys

The October 1 Survey was conducted by mail with nonrespondent follow-up on a subsample of the open segments enumerated in June. Operators in one-half the segments were chosen for the mail sample. All operators residing within these segments and reporting any crops in June were mailed questionnaires. Operators in one-half the segments (actually $\frac{1}{4}$ of the total segments) receiving the mail questionnaire were chosen for the nonrespondent interviews. Four hundred and five of the mail schedules were usable for one or more items. Three hundred and thirty nonrespondents were interviewed during the last week in September when the final objective yield survey was being conducted. In most cases, the same enumerators were used for both types of surveys. The December 1 Survey was modified to concentrate and speed up the interviewing in fewer counties. It was felt that any livestock survey at this time of year should be made in a very short period to reduce bias which might be associated with rapidly changing livestock numbers. Consequently, it was decided to conduct a separate or independent mail and interview survey. Farm operators in segments chosen for the October 1 Survey in one-half the counties were sent mail questionnaires. Farm operators in the segments chosen for October 1 nonrespondent interviews in the other half of the counties were selected for the December 1 interview sample. This gave a mail inquiry of operators in one-fourth the segments and an interview sample of operators in one-eighth of the segments. There were 309 usable mail returns or a 53 percent response to the inquiry and 325 farm operators were interviewed. The post-harvest objective yield interviews were also obtained at this time where practical.

No central training school for State Supervisor or enumerators was held. The costs are summarized in table 7.6.

Table 7.6 - Fields cost for October 1 and December 1 Surveys

Item	Cost
Salaries	$2,811.63
Mileage	1,015.33
Government car	46.00
Per Diem	258.00
Supplies	.71
Other	72.54
Total	$4,204.21

The direct cost totaled $2,817.81 and the absorbed costs were $1,386.40.

7.3. Objective Yield Surveys

The field activities were under the supervision of the State Statisticians' Offices in the States concerned. These surveys were conducted as of August 1, September 1, and October 1 for 400 corn fields and 400 cotton fields. Post-harvest interviews and field gleanings were carried out on a subsample of fields. The October 1 Survey and the final post-harvest survey were conducted at the same time as the October 1 acreage and Production Survey and the December 1 Livestock Survey. The sample fields were selected from those farms reporting the specified crop acreage in June. No central training school was held for State Supervisors, but personnel from Washington assisted the State Supervisor prior to the first survey in training enumerators during a one-day training session. The overall modification made in the procedures and sample size from 1954 resulted in substantially lower costs per field in 1955. The costs are summarized in table 7.7.

Table 7.7 - Cost of Objective Cotton and Corn Yield Surveys

Month	Total costs	Average costs per field
August 1	$11,278.29*	$14.80*
September 1	8,140.24	10.61
October 1	8,175.00	11.35
Post harvest	3,639.20	11.66
Total	$31,232.73	--

* Includes training costs

The direct costs totaled $21,398.66 and the absorbed costs $9,834.07. The absorbed costs were $8,138.30 in 1954 when the number of sample fields was only about 1/3 of the number used in 1955.